

PROJECT MANUAL

Grand Junction Regional Airport Level 2 Amenities & Elevator Modernization

Grand Junction, CO

Prepared by
Gensler
1225 17th St, Suite 150
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303.595.8585

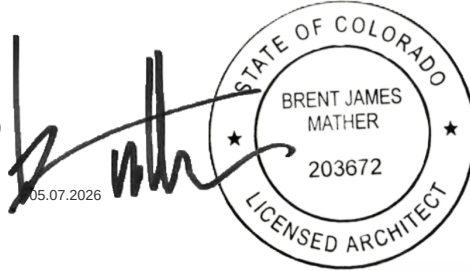
**Issue for Pricing & Permit
May 7, 2026**
Project Number 003.8017.012

Gensler
003.8017.012

May 07, 2026
Issue for Pricing & Permit

**GJT Level 2 Amenities and Elevator
Modernization**
Grand Junction, Colorado

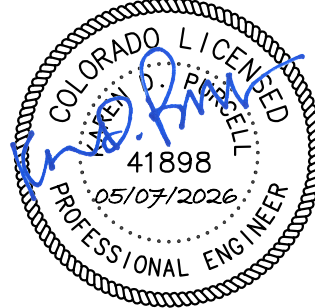
ARCHITECT
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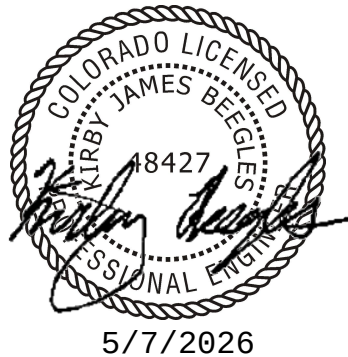
MECHANICAL ENGINEER
ME Engineers
14143 Denver West Parkway, Suite 300
Golden, CO 80401
303-421-6655



ELECTRICAL ENGINEER
PK Electrical, Inc.
4601 DTC Boulevard, Suite 720
Denver, CO 80237
720-481-3290



STRUCTURAL ENGINEER
Martin/Martin
12499 West Colfax Avenue
Lakewood, CO 80215
303-431-6100



ELEVATOR CONSULTANT
VDA (Van Deusen & Associates)
301 North Lake Avenue, 6th Floor
Pasadena, CA 91101
626-467-8013

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NOT APPLICABLE

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NOT APPLICABLE

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NOT APPLICABLE

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DOCUMENT 00 60 00 - PROJECT FORMS

PART 1 - GENERAL

1.1 FORM OF AGREEMENT AND GENERAL CONDITIONS

- A. The following form of Owner/Contractor Agreement and form of the General Conditions shall be used for Project:
 - 1. AIA Document A101, "Standard Form of Agreement between Owner and Contractor, Stipulated Sum."
 - a. The General Conditions for Project are specified in Document 00 72 00.
 - b. Supplementary Conditions are specified in Document 00 73 00.

1.2 ADMINISTRATIVE FORMS

- A. Copies of AIA standard forms may be obtained from the American Institute of Architects; <http://www.aia.org/contractdocs/purchase/index.htm>; docspurchases@aia.org; (800) 942-7732.
- B. Pre-Construction Forms:
 - 1. Form of Performance Bond and Labor and Material Bond: AIA Document A312, "Performance Bond and Payment Bond."
 - 2. Form of Certificate of Insurance: AIA Document G715, "Supplemental Attachment for ACORD Certificate of Insurance 25-S."
- C. Information and Modification Forms: Attached at the end of this Section.
 - 1. Submittal Transmittal.
 - 2. Requests for Interpretation (RFI).
 - 3. Substitution Request.
- D. Payment Forms:
 - 1. Schedule of Values Form: AIA Document G703, "Continuation Sheet."
 - 2. Payment Application: AIA Document G702/703, "Application and Certificate for Payment and Continuation Sheet."
 - 3. Form of Contractor's Affidavit: AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 - 4. Form of Affidavit of Release of Liens: AIA Document G706A, "Contractor's Affidavit of Payment of Release of Liens."
- E. Sustainable Design Requirements - Embodied Carbon:
 - 1. Environmental Product Declarations Reporting Form (EPD).

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END OF DOCUMENT 00 60 00



SUBMITTAL TRANSMITTAL

Project: _____ Date: _____
A/E Project Number: _____

TRANSMITTAL To (Contractor): _____ Date: _____ Submittal No. _____
A From (Subcontractor): _____ By: _____ ☐ Resubmission

Qty.	Reference / Number	Title / Description / Manufacturer	Spec. Section Title and Paragraph / Drawing Detail Reference

- ☐ Submitted for review and approval
☐ Resubmitted for review and approval
☐ Complies with contract requirements
☐ Will be available to meet construction schedule
☐ A/E review time included in construction schedule

- ☐ Substitution involved - Substitution request attached
☐ If substitution involved, submission includes point-by-point comparative data or preliminary details
☐ Items included in submission will be ordered immediately upon receipt of approval

Other remarks on above submission: _____

☐ One copy retained by sender

TRANSMITTAL To (A/E): _____ Attn: _____ Date Rec'd by Contractor: _____
B From (Contractor): _____ By: _____ Date Trnsmt'd by Contractor: _____

- ☐ Approved
☐ Approved as noted

- ☐ Revise / Resubmit
☐ Rejected / Resubmit

Other remarks on above submission: _____

☐ One copy retained by sender

TRANSMITTAL To (Contractor): _____ Attn: _____ Date Rec'd by A/E: _____
C From (A/E): _____ ☐ Other By: _____ Date Trnsmt'd by A/E: _____

- ☐ Approved
☐ Approved as noted
☐ Not subject to review
☐ No action required
☐ Revise / Resubmit
☐ Rejected / Resubmit
☐ Approved as noted / Resubmit

- ☐ Provide file copy with corrections identified
☐ Sepia copies only returned
☐ Point-by-point comparative data required to complete approval process
☐ Submission Incomplete / Resubmit

Other remarks on above submission: _____

☐ One copy retained by sender

TRANSMITTAL To (Subcontractor): _____ Attn: _____ Date Rec'd by Contractor: _____
D From (Contractor): _____ By: _____ Date Trnsmt'd by Contractor: _____

Copies: ☐ Owner ☐ Consultants ☐ _____ ☐ _____ ☐ _____ ☐ One copy retained by sender



Advancement
of Construction
Technology

SUBCONTRACTORS AND MAJOR MATERIAL SUPPLIERS LIST

Project: _____ From (Contractor): _____

Date: _____
To (A/E): _____ A/E Project Number: _____

Contract For: _____

List Subcontractors and Major Material Suppliers proposed for use on this Project as required by the Construction Documents. Attach supplemental sheets if necessary.

Section Number	Section Title	Firm	Address	Phone Number (Fax Number)	Contact
-------------------	------------------	------	---------	------------------------------	---------

☐ Attachments

Signed by: _____

Date: _____

Copies: ☐ Owner ☐ Consultants ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ File

Project	RFI Number	
To	Date	
Attention	Project Number	
From	File	6RFI
Issued By	Drawing Sheet / Location	
Subject	Detail	
Distribution	Specifications Page Number	
	This is page	1 of

Problem, Cause and Proposed Solution (attach sketches as necessary)

Effect on Schedule

Effect on Cost

Reply

Reply Needed by

Signature

Date

Project	Date
Project Location	Project Number
General Contractor	File6S
Prepared by	This is page1 of

We certify that the following product is equal or superior to the specified product in appearance, durability, performance, and in every other respect, and we hereby submit it for your consideration as a substitute for the specified item for the above-mentioned project:

1. Specified Item

Section
2. Proposed Substitution
3. Reason for Substitution
4. Costs (Provide a complete breakdown of costs, including the cost amount to be DEDUCTED from the Contract Sum if the proposed substitution is accepted. Include documentation for both materials and labor.)
5. Schedule (Describe substitution's affect on construction schedule)
6. Supporting Data
 - Cutsheets: Attach complete technical data, including laboratory tests, if applicable.
 - Installation: Include complete information on changes to Drawings and/or Specifications describing the steps that the proposed substitution will require for its proper installation.
 - Samples: Submit with request all necessary samples and substantiating data clearly marked to prove equal quality and performance to that which is specified.
7. List ways in which the substitution affects dimensions shown on Drawings
8. List affects of proposed substitution on other trades
9. List ways in which proposed substitution will be affected by applicable code requirements and agency approval
10. List differences between proposed substitution and specified item
11. Manufacturer's warranties of the proposed and specified items are:

☐ Same☐ Different
- Explain:

12. List information on availability of maintenance service and source of replacement materials

13. Certification of, and Assumption of Liability for, Equivalent Performance

The undersigned certifies that the function, appearance and quality of the proposed substitution is equivalent or superior to the specified item and is in full compliance with the Contract Documents and applicable regulatory requirements.

Supplier	_____	Signature	_____
Telephone No.	_____	Date	_____

Signature must be by person authorized to legally bind his/her firm to the above terms. Failure to provide legally binding signature will result in retraction of approval.

General Contractor	_____	Signature	_____
Telephone No.	_____	Date	_____

Project			Date		
Project Location			Architect's Project Number		
Owner/Client			File 6BL This is page 1 of		
To			Attention		
Address					
City		State		Zip Code	
Delivered via:					
☐ Messenger		☐ Hand carried		☐ Facsimile	
☐ Express		☐ Pick-up		☐ E-mail Address	
☐ Mail		☐ UPS		☐ Website Address	
This Bulletin Conveys to Contractor (Check one of the following five choices.):					
☐ Architect's Authorization for Minor Changes Architect recommends modifications to the Work as described below.					
☐ Architect's Clarification / Supplemental Instructions (Use this Bulletin form in place of <i>Architect's Supplemental Instructions</i> form.) Contractor shall carry out the Work in accordance with the following supplemental instructions.					
☐ Architect's Confirmation of a Field Order (Use this Bulletin form in place of a <i>Field Order</i> form.) This confirms Architect's verbal instructions to (individual's name) _____ on (date) _____, as described below. Note: The above three choices are each subject to the following terms: The change(s), clarification(s) and/or confirmation(s) described below is/are issued in accordance with the Contract Documents, without change in Contract Sum and/or Time.					
☐ Architect's Request for Contractor's Proposal (Use this Bulletin form in place of an <i>Estimate Request</i> form.) Please submit an itemized proposal for changes in the Contract Sum and/or Time for proposed modifications to the Contract Documents described herein. Submit proposal within _____ days or notify the Architect in writing of the date on which you anticipate submitting your proposal. This is not a Change Order or a Construction Change Directive or a direction to proceed with the Work described in the proposed modifications.					
☐ Other: As described below.					
Attachments					
Requested by					
☐ Architect ☐ Owner ☐ Contractor ☐ Other (specify): _____					
Issued by Gensler by			Date Signed		
Issued by Owner by			Date Signed		
☐ Required; Please return signed copy to Gensler			☐ Not Required		
Accepted by Contractor by			Date Signed		
☐ Required; Please return signed copy to Gensler			☐ Not Required		
Distribution					
Prepared by Gensler by			Date Signed		
Instructions / Description / References / Dates					

Begin text here...

Project		Date	
Project Location		Project Number	
Owner / Client	File	6CO	This is page 1 of
Contractor		Contractor's Request / Quotation Number / Date	
Change to Contract Sum:	Choose One:	Change to Contract Time:	
Original Contract Amount:	Choose One:	Revised Contract Amount:	Choose One:
☐ See Change Order Summary for Revised Total Contract Amount and Time			
Reason for Change		Requested by	
Recommended for Approval by Gensler: by	By Por	Date Signed	
Approved for Owner / Client	By	Date Signed	
Approved for Contractor	By	Date Signed	
Approved for Tenant (if applicable)	By	Date Signed	
The above Change Order to the contract shall be effective upon signature by all applicable parties, in accordance with the Conditions of the Contract. The Contract Amount refers to the Contract Sum or guaranteed Maximum Cost in the Contract.			
Distribution			
Description / References / Costs / Dates			
Begin text here . . .			

Project		Date of Observation	
Project Location		Project Number	
List Number	File	6PL	
This is page		1 of	

Present

Field review by Gensler disclosed the item(s) listed below, which is/are not in accordance with the Contract Documents. Contractor shall, upon receipt of this list, and before Gensler issues the Certificate of Substantial Completion, proceed promptly to complete and correct the item(s) and shall then submit a request for another field review by Gensler to determine Substantial Completion. This list supplements Contractor’s Punch List and, unless otherwise noted, supersedes Gensler’s previous list(s). Gensler will rely on this list as the approved record of matters discussed and conclusions reached, unless Contractor’s written notice to the contrary is received by Gensler within seven calendar days of the date this list was issued.

Distribution

Prepared by	Date Issued
-------------	-------------

Space / Item Number / Descriptions / Observations

Certificate of Substantial Completion

Gensler

Project	Project Number	
Project Location	Date Issued	
Owner / Client	File	6SC
Contract Date	This is Page	1 of
Date of Substantial Completion		

Date of Substantial Completion is applicable to	☐ Entire Project	☐ Designated Portion of Project, as described below	
Punch List	☐ Attached	☐ Transmitted Separately	☐ None

The Work performed under the Contract for Construction has been reviewed and found, to Architect's best knowledge, information and belief, to be substantially complete as of the Date of Substantial Completion entered above. The Date of Substantial Completion is the date when the Work, or designated portion thereof, is sufficiently complete in accordance with the Contract Documents (including any approved change Orders) and all required final inspections and permits have been obtained so Owner can occupy or utilize the Work for its intended use, subject only to completion of minor items (Punch List).

The Work, or designated portion thereof shall include:

A list of items to be completed or corrected and the date(s) when such items are to be completed (Punch List) may be attached hereto or transmitted separately. This Certificate of Substantial Completion or omission of any item from the Punch List shall not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. The Architect shall not be responsible for any omission from, or other discrepancy on, the Punch List. Contractor agrees to complete or correct the items listed on the Punch List within days of the above date of Substantial Completion.

Warranties required under the Contract Documents shall commence on the Date of Substantial Completion, except for Punch List items and other incomplete work, warranties for which shall commence on the date such work is satisfactorily completed, unless otherwise agreed in writing by Owner and Contractor.

The Owner and Contractor shall fulfill and transfer responsibilities with regard to insurance, utilities, maintenance, damage, security, surety, and the like, in accordance with the Contract Documents or other written agreement between them.

The Architect has conducted no tests for, and made no determination of the presence or lack of asbestos or other hazardous or toxic substances or pollutants.

The Basic Services of the Architect shall end 30 days after the Date of Substantial Completion, unless otherwise stated in the Owner/Architect Agreement or agreed in writing.

Begin text here . . .

Architect	Gensler	By	Date Signed
Owner / Client		By	Date Signed

Project		Project Number
Project Location		2 of
Contractor	By	Date Signed

Project Name	This Standard Product Review Form is to be used to streamline the submittal of manufacturer's standard product data and samples for materials like ceiling tile, vinyl flooring, carpet or other systems for which manufacturer's product data is readily available. It is intended that this form is used only for materials that are commonly available in the marketplace and meet the specified requirements; or are the material used as the "basis of design". It is not to be used for any other purpose	Gensler Project Number	
General Contractor		Date Received	
Subcontractor(s) List as needed		Date Returned	
		Reviewed by:	

Item No	Specification Section Product Description	Name of Manufacturer	Meets or Exceeds Technical Requirements		Meets or Exceeds LEED Requirements		Environmental Product Declaration Available		Remarks If answered NO to any requirement provide an explanation or offer an alternative product
			Yes	No	Yes	No	Yes	No	
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

Provide other Data or descriptions here...

Waste Management Plan Summary

(Submit after Award of Contract and prior to Start of Work)

Gensler

Project Title:		
Contract or Work Order No.:		
Contractor's Name:		
Street Address:		
City:	State:	Zip:
Phone: ()	Fax: ()	
E-Mail Address:		
Prepared by: (Print Name)		
Date Submitted:		
Project Period:	From:	To:

Reuse, Recycling or Disposal Processes to Be Used

Describe the types of recycling processes or disposal activities that will be used for material generated in the project to *achieve the required 80% diversion rate*. Indicate the type of process or activity by number, types of materials, and estimated quantities that will be recycled or disposed in the sections below:

- 01 - Reuse of building materials or salvage items on site (i.e. crushed base or red clay brick)
- 02 - Salvaging building materials or salvage items at an off site salvage or re-use center (i.e. lighting, fixtures)
- 03 - Recycling source separated materials on site (i.e. crushing asphalt/concrete for reuse or grinding for mulch)
- 04 - Recycling source separated materials at an off site recycling center (i.e. scrap metal or green matls)
- 05 - Recycling commingled loads of C&D matls at an off site mixed debris recycling center or transfer station
- 06 - Recycling material as Alternative Daily Cover at landfills
- 07 - Delivery of soils or mixed inerts to an inert landfill for disposal (inert fill).
- 08 - Disposal at a landfill or transfer station.
- 09 - Other (please describe)

Types of Material to Be Generated

Use these codes to indicate the types of material that will be generated on the project

A = Asphalt	C = Concrete	M = Metals	I = Mixed Inert	G = Green Matls
D = Drywall	P/C=Paper/Cardboard	W/C = Wire/Cable	W = Wood	O = Other (describe)
M/C = Miscellaneous Construction Debris	R = Reuse/Salvage	S= Soils (Non Hazardous)		

Facilities Used: Provide Name of Facility and Location (City)

Total Truck Loads: Provide Number of Trucks Hauled from Site During Reporting Period

Total Quantities: If scales are available at sites, report in tons. If not, quantify by cubic yards. For salvage/reuse items, quantify by estimated weight (or units).

SECTION 1 - RE-USED/RECYCLED MATERIALS

Include all recycling activities for source separated or mixed material recycling centers where recycling will occur.

Type of Material	Type of Activity	Facility to Be Used / Location	Total Truck Loads	Total Quantities		
				Tons	Cubic Yd.	Other Wt.
a. Total Diversion						

SECTION 2 - DISPOSED MATERIALS						
<i>Include all disposal activities for landfills, transfer stations, or inert landfills where no recycling will occur.</i>						
Type of Material	Type of Activity	Facility to Be Used / Location	Total Truck Loads	Total Quantities		
				Tons	Cubic Yd.	Other Wt.
b. Total Disposal						

SECTION 3 - TOTAL MATERIALS GENERATED						
<i>This section calculates the total materials to be generated during the project period (Reuse/Recycle + Disposal = Generation)</i>						
				Tons	Cubic Yd.	Other Wt.
a. Total Reused/Recycled						
b. Total Disposed						
c. Total Generated						

Add totals from Section 1 + Section 2					
	Tons	Cubic Yards	Other Wt.		
a. Materials Re-Used and Recycled					
b. Materials Disposed					
c. Total Materials Generated (a. + b. = c.)					
d. Landfill Diversion Rate (Tons Only)* (a / c)	Min. 80% Diversion Required				

** Use tons only to calculate recycling percentages: Tons Reused/Recycled/Tons Generated = % Recycled*

1. Suggested Conversion Factors: From Cubic Yards to Tons (Use when scales are not available)
 Asphalt: 0.61 (ex. 1000 CY Asphalt = 610 tons. Applies to broken chunks of asphalt)
 Concrete: 0.93 (ex. 1000 CY Concrete = 930 tons. Applies to broken chunks of concrete)
 Gypsum Board Scrap: 0.20
 Ferrous Metals: 0.22 (ex. 1000 CY Ferrous Metal = 220 tons)
 Non-Ferrous Metals: 0.10 (ex. 1000 CY Non-Ferrous Metals = 100 tons)
 Wood Scrap: 0.16

(Submit with Each Progress Payment)

(Submit with Each Progress Payment)

Project Title:		
Contract or Work Order No.:		
Contractor's Name:		
Street Address:		
City:	State:	Zip:
Phone: ()	Fax: ()	
E-Mail Address:		
Prepared by: (Print Name)		
Date Submitted:		
Project Period:	From:	To:

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Describe the types of recycling processes or disposal activities that will be used for material generated in the project to **achieve the required 80% diversion rate**. Indicate the type of process or activity by number, types of materials, and estimated quantities that will be recycled or disposed in the sections below:

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[illegible]

Total Truck Loads: Provide Number of Trucks Hauled from Site During Reporting Period

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SECTION 1 - RE-USED/RECYCLED MATERIALS

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Type of Material	Type of Activity	Facility to Be Used / Location	Total Truck Loads	Total Quantities		
				Tons	Cubic Yd.	Other Wt.
a. Total Diversion						

SECTION 2 - DISPOSED MATERIALS						
<i>Include all disposal activities for landfills, transfer stations, or inert landfills where no recycling will occur.</i>						
Type of Material	Type of Activity	Facility to Be Used / Location	Total Truck Loads	Total Quantities		
				Tons	Cubic Yd.	Other Wt.
b. Total Disposal						

SECTION 3 - TOTAL MATERIALS GENERATED						
<i>This section calculates the total materials to be generated during the project period (Reuse/Recycle + Disposal = Generation)</i>						
				Tons	Cubic Yd.	Other Wt.
a. Total Reused/Recycled						
b. Total Disposed						
c. Total Generated						

Add totals from Section 1 + Section 2					
	Tons	Cubic Yards	Other Wt.		
a. Materials Re-Used and Recycled					
b. Materials Disposed					
c. Total Materials Generated (a. + b. = c.)					
d. Landfill Diversion Rate (Tons Only)* (a / c)	Min. 80% Diversion Required				

** Use tons only to calculate recycling percentages: Tons Reused/Recycled/Tons Generated = % Recycled*

Contractor's Comments (Provide any additional information pertinent to planned reuse, recycling, or disposal activities):

Notes:

1. Suggested Conversion Factors: From Cubic Yards to Tons (Use when scales are not available)
- | | |
|---------------------|--|
| Asphalt: | 0.61 (ex. 1000 CY Asphalt = 610 tons. Applies to broken chunks of asphalt) |
| Concrete: | 0.93 (ex. 1000 CY Concrete = 930 tons. Applies to broken chunks of concrete) |
| Gypsum Board Scrap: | 0.20 |
| Ferrous Metals: | 0.22 (ex. 1000 CY Ferrous Metal = 220 tons) |
| Non-Ferrous Metals: | 0.10 (ex. 1000 CY Non-Ferrous Metals = 100 tons) |
| Wood Scrap: | 0.16 |

Environmental Product Declaration Reporting Form

Gensler

Project Name	Project Location		
General Contractor	Date		
Subcontractor	File	6ER	This is page 1 of

The information below identifies the status of a Type III Environmental Product Declaration in accordance with ISO 14025 for the product(s) listed below.

Manufacturer	Product
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☐ The product listed above has available one of the following Type III Environmental Product Declarations:

☐ Product-Specific Type III Environmental Product Declaration. **See attached.**
☐ Industry-Wide (Generic) Type III Environmental Product Declaration. **See attached.**

☐ A Type III Environmental Product Declaration is IN DEVELOPMENT for the product listed above and will be published by the provided date:

Date:

☐ A Type III Environmental Product Declaration is NOT AVAILABLE for the product at this time.

We certify that the following information is accurate to the best of our knowledge at the time of submission.

Contractor Signature	Date
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SECTION 010000 - GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements.

1.2 MISCELLANEOUS PROVISIONS

- A. Execution of the Contract by Contractor is a representation that Contractor has visited the site, become familiar with local conditions under which the Work is performed and correlated personal observations with requirements of the Contract Documents. Contractor acknowledges and agrees that the information contained in the Contract Documents is adequate and sufficient for completion of the Work.
- B. The Contractor shall notify and apprise all Subcontractors and any other parties to the Contract of, and bind them to the conditions of the Owner-Contractor Agreement.
- C. The provisions of the Owner-Contractor Agreement, including General and Supplementary Conditions, when included, and Section 010000 "General Requirements" apply to the Work specified in each Section of the Specifications.
- D. Where conflicts occur concerning the Architect's duties and responsibilities between the General Conditions and the Agreement between the Owner and Architect, the Agreement shall take precedence.
- E. If not otherwise included in the Owner-Contractor Agreement or specifically included in the procurement documents, obtain the Owner's insurance requirements prior to submitting a bid or a proposal.
 - 1. Contractor's Commercial General Liability insurance shall contain no exclusion that denies coverage for claims arising out of or contributed to by fungi, mildew, mold, or resulting allergens. If exclusion exists and cannot be removed by endorsement, submit proof of coverage for fungi, mildew, mold, or resulting allergens under a Pollution Legal Liability or Contractor's Pollution Liability policy. Coordinate with the Owner for required insurance type and amounts.
- F. Work by Owner: Items noted NIC are provided by Owner or under separate contract including work identified as systems furniture.
- G. Work under Other Contracts: Owner reserves the right to award separate contracts for other work. Coordinate work under the contract required for smooth completion of the work.

- H. The Work shall comply with the Airport Construction Standards (U.S. Department of Transportation Federal Aviation Administration Advisory Circular AC No. 150/5370-10).
- I. The Work shall comply with the FAA Airport Improvement Program (AIP) Grant Requirements including the Federal Contract Provisions for AIP and Obligated Sponsors.

1.3 WORK RESTRICTIONS

- A. Contractor Use of Site: Limit use of site to extent required to perform Work and to limits indicated on Drawings.
 - 1. Keep entrances clear and available to building management, tenants and emergency vehicles.
 - 2. Do not block entrances, fire exits or lanes, or delivery routes.
 - 3. Do not use areas for parking or storage of materials.
 - 4. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.
 - 5. Arrange access to Work area through Building Management. Do not disturb Owner, tenant, or building operations.
 - 6. Arrange schedule of deliveries through Building Management.
 - 7. Repair damage caused by construction operations. Protect building and its occupants during construction period.
 - 8. Comply with Building regulations and procedures for construction work.
- B. Noise Control: Minimize objectionable noise levels and notify Owner in advance of noisy operations. Do not operate gasoline and diesel engine driven tools and pump equipment on Project site without specific prior written approval from Owner and Architect. The Owner and Building Management reserve the right when necessary to require excessive noise transmitting procedures be stopped during certain periods of time.
- C. Occupancy:
 - 1. Owner Occupancy: The Owner will be occupying the space during construction activities.
 - 2. Adjacent Occupancy: Adjacent floors of the building will be occupied during construction. Do not close or obstruct walkways, corridors, or occupied or used facilities without written permission from Building Management, Owner, and authorities having jurisdiction.
 - 3. Provide minimum 72 hours notice to Building Management and Owner of activities that affect building or tenant operations.
 - 4. Owner reserves the right to place and install equipment in completed areas, prior to Substantial Completion providing occupancy does not interfere with completion of the Work. Placing of equipment does not constitute acceptance of the total Work.

1.4 SUBSTITUTION PROCEDURES

- A. Changes in the products, materials, equipment, systems, and methods of construction specified in the Contract Documents are considered substitutions. When substitutions are considered, submit substitution request with adequate time for the Architect to review and consider the substitution request.
1. Substitutions will not be considered for acceptance:
 - a. When indicated and implied on shop drawings and product data submittals;
 - b. When acceptance will require substantial revision of Contract Documents;
 - c. When, in judgment of Architect, do not include adequate information necessary for a complete evaluation.
 2. Substitutions after Award of the Contract may be considered by the Architect. Make request on form available from the Architect. Include the following:
 - a. Product identification and description (marketing brochures and guide specifications are not acceptable; provide manufacturer technical data and ICC-ES Research/Evaluation Reports).
 - b. Substantiating data indicating compliance with performance and test data, including Global Warming Potential and other Embodied Carbon criteria where applicable.
 - c. References.
 - d. Samples.
 - e. Itemized comparison of the proposed substitution with the product specified.
 - f. Data relating to Contract time, schedule, design, visual effect.
 - g. Compatibility with adjacent materials.
 - h. Submit complete and accurate cost data and compare the proposed substitution with the product specified regardless if the Contract Sum is affected. Include cost data for adjacent work affected by the proposed substitution.
 3. Do not order and install substitute products, systems, equipment, and change sequencing without written acceptance of the Request for Substitution by Architect and Owner. Submission of the Request for Substitution does not constitute an approval. If the request is rejected for any reason, the rejection is considered final.
 4. In making formal request for substitution, Contractor represents to the Owner and the Architect that:
 - a. It has investigated proposed substitution and has determined it is equivalent to or superior in every respect to the specified product or materials, will fit into the space provided, and is compatible with adjacent materials.
 - b. It will provide the same or better warranties.

- c. It certifies cost data is complete and includes related costs under the Contract and waives claim to additional cost related to the proposed substitution which subsequently become apparent.
 - d. It accepts responsible for delays and costs caused by the substitution if approved unless delays and costs are specifically mentioned and approved on the Request for Substitution Form by the Owner and the Architect.
 - e. It will coordinate the installation of the accepted substitute, making changes required for the Work to be complete in all respects.
- 5. Architect will solely determine acceptability of proposed substitutions.
 - 6. The Contractor bears full responsibility for investigating and providing supporting data for proposed substitution. Requests for substitutions that are not accompanied by complete supporting data and are not submitted on the Architect's form will be returned without review or comment.

1.5 CONTRACT MODIFICATION PROCEDURES

- A. Minor Changes in the Work: Architect may issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.
- B. Proposal Requests:
 - 1. Owner Initiated Proposal Requests: Architect will issue a description of proposed changes that may require adjustment to the Contract Sum or the Contract Time.
 - a. Proposal Requests issued by Architect are for information only. Do not interpret instructions to stop Work in progress or to execute a proposed change.
 - b. Within 5 days after receipt of Proposal Request, submit quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts. Include an updated Contractor's Construction Schedule that indicates the effect of the change. Use available total float before requesting an extension of the Contract Time.
 - 2. Contractor Initiated Proposals (Change Order Requests): Propose changes by submitting a request for a change.
 - a. Include statement that outlines reasons for the change and the effect of the change on the Work. Provide complete description of the proposed change. Indicate effect of proposed change on the Contract Sum and the Contract Time.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include an updated Contractor's Construction Schedule that indicates effect of change. Use available total float before requesting an extension of the Contract Time.

- d. Comply with requirements if the proposed change requires substitution of one product or system for product or system specified.
 - C. Change Order Procedure: On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor.
- 1.6 REQUESTS FOR INTERPRETATION (RFI)
- A. Use an RFI to ask questions related to the Work; subject to the conditions contained within this Article.
 - B. Authorship: Contractor.
 - C. Prohibitions: RFI shall not be used for the following:
 - 1. Request for approval of substitutions.
 - 2. To request an adjustment of the Contract Time or Contract Sum.
 - 3. To request interpretation of Architect's action on submittals.
 - 4. To transfer coordination responsibility from the Contractor to the Owner or the Architect.
 - D. Procedure:
 - 1. Each RFI shall address one subject.
 - 2. Each RFI shall contain specific reference to the drawing number(s), detail number(s), schedule type(s), bulletin number(s), specification section(s) and paragraph number(s), or other related document(s) pertinent to the Contractor's question. The date of each referenced drawing number, bulletin, specification section or other related document shall be identified. In preparing each RFI, verify the applicable dimension(s), field conditions, drawing requirements (small through large scale details), and/or specification section requirements pertaining thereto. Where supplementary sketches are required to clarify an inquiry, attach supplementary sketches, at large scale, illustrative of the inquiry. Sketches shall include sufficient detail, materials, dimensions, thicknesses, assembly, attachments, relation to adjoining work, structural grid references, and all other pertinent data and information for the Architect to make an informed response. Suggest solution(s) to inquiries, if applicable. Should the Contractor's solution(s) have an impact on Contract Sum or Contract Time, it shall be so stated within the RFI.
 - 3. Each RFI shall be dated and sequentially numbered.
 - 4. Each RFI shall be reviewed and signed by the Contractor prior to transmitting to the Architect.
 - 5. Duration of RFI Response Upon Receipt: 5 business days.

1.7 PAYMENT PROCEDURES

- A. Schedule of Values: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.

1. Submit the Schedule of Values, on AIA Document G703, prior to date scheduled for submittal of initial Applications for Payment.
2. Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
3. Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate. Break down principal subcontract amounts into separate labor and materials items. Break down of subcontractor's schedule of values must be true and accurate.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item. Temporary facilities and other major cost items that are not direct cost of actual Work in place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
6. Update and resubmit Schedule of Values before the next Application for Payment when Change Orders result in a change in the Contract Sum.

B. Applications for Payment:

1. Upon receipt of final Application and Certificate for Payment and required documentation including the updated Schedule of Values and the updated Construction Schedule, the Architect shall make a final review. Upon completion of review, Architect shall revise, if necessary, and execute the Applications and Certificate for Payment and forward executed copies to the Owner.
 - a. In taking action on Application and Certificate for Payment, the Architect relies on accuracy and completeness of information furnished and does not represent that Architect audited supporting data.
 - b. Payment will not be made for materials and equipment stored off site, except at Owner's discretion and written approval. When Application and Certificate for Payment includes material or equipment stored off site, accompany Application by a statement certifying:
 - 1) Description of the item(s) being stored.
 - 2) Location of the bonded warehouse(s) where materials or equipment is being stored.
 - 3) Affidavit of Storage.
 - 4) Certificate of Insurance.
 - 5) Bill of sale made to Owner stating there will be no additional cost for transportation and delivery of the item(s) being stored.
 - 6) Statement certifying that item or a part thereof will not be installed in construction other than Work under this Contract.
2. Use AIA Document G702 and AIA Document G703 Continuation Sheets.
3. Complete every entry on form. Notarize and execute by authorized individual. Incomplete applications will be returned without action.

4. Submit 1 signed and notarized digital copy of each Application for Payment. Copy shall include waivers of lien and similar attachments if required. Transmit copy with a transmittal form listing attachments and recording appropriate information about application.
- C. Waivers of Mechanic's Lien: Submit notarized waivers of mechanic's lien from each entity lawfully entitled to file a mechanic's lien arising out of the Contract and related to Work covered by the payment.
1. Submit partial waivers on each item for amount requested, before deduction for retainage.
 2. When an application shows completion of an item, submit final or full waivers.
 3. Owner reserves the right to designate which entities must submit waivers.
 4. Submit each Application for Payment with Contractor's waiver of mechanic's lien for construction period covered by the application. Submit final Application for Payment with or proceeded by final waivers from every entity involved with performance of work covered by the application lawfully entitled to a lien.
 5. Submit executed waivers of lien on forms acceptable to Owner.
- D. Initial Application for Payment: Submit administrative actions and submittals that precede or coincide with submittal of first Application for Payment:
1. Schedule of Values.
 2. Contractor's Construction Schedule (preliminary if not final).
 3. Copies of building permits.
 4. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 5. Certificates of insurance and insurance policies.
 6. Data needed to acquire Owner's insurance coverage(s).
 7. Performance and payment bonds, if required.
- E. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim and statement showing an accounting of changes to the Contract Sum.
 2. The application reflects Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- F. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to:
1. Evidence of completion of Project closeout requirements, including, but not limited to transmittal of required Project Record Drawings to Owner.
 2. Insurance certificates for products and completed operations and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706 Contractor's Affidavit of Payment of Debts and Claims and AIA Document G706A Contractor's Affidavit of Release of Liens.

5. AIA Document G707 Consent of Surety to Final Payment.
6. Evidence that claims have been settled.

1.8 PROJECT MANAGEMENT AND COORDINATION

- A. Coordination: Coordinate scheduling, submittals, and Work of various Specification Sections to assure efficient and orderly sequence of installation of interdependence. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate space requirements and installation of mechanical and electrical work indicated on Drawings. Follow routing shown for pipes, ducts, and conduit as closely as possible. Conceal pipes, ducts, and wiring within construction in finished areas.
- B. Conferences and Meetings: Preside at meetings, record minutes, and distribute typed copies within two days following each meeting. Schedule preconstruction conference after Notice of Award.
 1. Conduct progress meetings at weekly intervals.

1.9 SUBMITTALS

- A. Submittal Procedures:
 1. Coordinate preparation and processing of submittals with performance of construction activities.
 2. Place a permanent label or title block on each submittal for identification. Indicate name of firm or entity that prepared each submittal on label or title block. Identify project, Contractor, subcontractor or supplier, specification section and drawings sheet number, and pertinent references and data. Assign unique identifier, including revision number, numbered consecutively. Retain numbering system throughout revisions
 3. Review and coordinate each shop drawing for constructability and compliance with Contract Documents. Apply Contractor's stamp, sign, and certify review and verification of materials required, field dimensions, adjacent construction work, and coordination of information in accordance with requirements.
 4. Identify variations from Contract Documents and material or system limitation affecting performance of the completed Work.
 5. Incomplete submittals will be returned without comment for completion of the submittal.
 6. Revise and resubmit as required; identify changes made since previous submittals.
 7. Package each submittal individually and appropriately for transmittal and handling using transmittal form. Submittals received from sources other than Contractor will be discarded unopened.
 8. Use final submittals with mark indicating action taken by Architect in connection with construction.
- B. Submittal Preparation: Submit each submittal electronically, unless otherwise indicated. Mark and retain submittal copy as a Project Record Document.

- C. Processing Time: Promptly submit Shop Drawings, Product Data, and Samples as to cause no delay in the Work. Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. Architect will document on submittal the date of receipt. Submittals delivered to the Architect after 4 pm will be noted as received on the next business day.
1. Initial Review: Allow 10 working days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination. Delaying submittals to facilitate coordination between submittals shall not constitute a delay of the Work nor shall it be the basis for an extension of time.
 2. Sequential Review: Sequential review is a submittal that requires review by more than one design discipline. Where sequential review of submittals by Architect's consultants, Owner, or other parties is required, time shall be allocated to reflect sequential review.
 3. Allow 10 working days for review of each resubmittal.
 4. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
- D. Construction Progress Schedules: Submit initial schedule within 10 days after date of Agreement for review.
1. Submit revised schedules with each Application for Payment, identifying changes since previous version. Indicate estimated percentage of completion for each item at each submission.
 2. Submit horizontal bar chart with separate line for each major section of work or operation, identifying first day of each week.
- E. Shop Drawings: Prepare project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data. Submit one electronic copy for Architect's review.
- F. Samples: When specified, submit full size, fully fabricated samples cured and finished as specified and physically identical with material or product proposed, including partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.
- G. Manufacturer's Certifications: Submit electronic copy of certifications to Architect for review, indicating material or product compliance with specified requirements. Submit supporting data, affidavits, and certifications electronically.

1.10 QUALITY REQUIREMENTS

- A. Control of Installation: Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship to produce Work of specified quality.
1. Comply with manufacturer's instructions.

2. Comply with specified standards as a minimum quality for Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
 - a. Comply with reference standards by date of issue current as of date of Contract Documents. In the event of conflict, request clarification from Architect prior to commencement of Work.
 - b. If compliance with two or more standards result in conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.
 - B. Inspection and Testing Laboratory Services: Unless otherwise noted, Owner will employ and pay for services of an independent firm to inspect and test the work.
 1. Cooperate with the inspection and testing agencies; furnish samples of materials, design mix, equipment, tools, storage, and assistance as requested.
 2. Notify agency minimum 24 hours in advance for operations requiring services.
 3. Make arrangements and pay for additional samples and tests required for Contractor's use.
 4. Comply with requirements of individual Specification Section.
 5. Testing Laboratory Criteria: Independent agency having National Bureau of Standards (CCRL) certification.
 - C. Special Tests and Inspections: Where required by Code or Specifications, Owner will engage a qualified testing agency or special inspector to conduct special tests and inspections required by Code or authorities having jurisdiction as the responsibility of Owner.
 - D. Repair and Protection: On completion of testing, inspecting, and sample taking, repair damaged construction and restore substrates and finishes.
 1. Protect construction exposed by or for quality control service activities.
 2. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality control services.
- 1.11 TEMPORARY FACILITIES AND CONTROLS
- A. Regulatory Requirements:
 1. Building Code, including local requirements for permits, testing and inspection.
 2. Health and safety regulations.
 3. Fire protection regulations.
 4. Utility company regulations and recommendations governing temporary utility services.
 5. Police, Fire Department, and Emergency or Rescue Squad rules and recommendations.
 6. Applicable industry standards cited in individual specification sections.

- B. Conditions of Use: Keep clean and neat; operate in a safe and efficient manner. Do not overload facilities or permit them to interfere with progress. Do not allow hazardous, dangerous, or unsanitary conditions or public nuisances to develop.
1. Take necessary fire prevention measures. Maintain facilities in sanitary condition.
 2. Maintain site security and protect facilities in a safe, lawful, and publicly acceptable manner.
 3. Installer of each permanent utility is responsible for its operation, maintenance, and protection if used for construction services during the construction period.
 4. Do not overload temporary services or facilities, and do not permit them to interfere with the progress of the Work. Do not allow unsanitary conditions, public nuisances, or hazardous conditions to develop or persist on the site.
 5. The use of powder actuated tools is prohibited except by written approval of the Owner. Complete the work using other means. Should it not be practical or deemed too expensive in time or dollars, request permission in writing with complete explanation and description of procedure together with suitable credit. Do not bring tools or ammunition onto the site without written approval of the Owner.
- C. Construction Office: Use area within existing building designated by Owner. Restore to original condition upon completion of the Work.
- D. Continuation of Services: When necessary to temporarily shut down building or portion of building due to mechanical or electrical change over, notify Owner in writing minimum 72 hours in advance and schedule shut down to accommodate Owner and staff. Shut downs must be of limited duration, scheduled, and written approval obtained from Owner.
1. Limit durations of shutdowns and schedule to accommodate both the Contractor and the Owner. The shut down must yield to Owner's needs and is not justification for additional compensation unless approved by the Owner as above and beyond normal project shut down.
- E. Existing and Temporary Utilities: Connecting into existing utilities and services is permitted to the extent it is available. Assume full responsibility for the systems including cleaning and restoration and practice energy conservation. Provide hook ups and extensions required.
1. Provide branch ducts as required. Maintain minimum ambient temperature of 50 deg F in areas where construction is in progress unless otherwise indicated.
 2. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust of fumes, vapors, and gases.
 3. Provide and maintain plumbing and water for construction services. Provide hoses, branch piping, and connections required.
 4. Use designated toilet facilities, wash facilities, and drinking water fixtures designated by Owner. Maintain clean and sanitary facilities.
- F. Telephone Service: Provide, maintain, and pay for cellular phone for Contractor's superintendent's use.

- G. Barriers: Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage in compliance with governing authorities.
- H. Scaffolding, Hoists, Stays, Ladders: Comply with NFPA 241.
- I. Temporary Enclosures, Partitions, and Protections: When temporary enclosures or partitions are necessary, provide fire retardant treated lumber.
 - 1. Provide dustproof partitions and barriers as required or as indicated to prevent spreading dust and fumes to occupied portions of the building. Construct from minimum 4 inch studs, Type X gypsum board with taped joints on occupied side, 1/2-inch-thick fire retardant treated plywood on demolition or construction side, and fill partition cavity with sound deadening materials.
- J. Parking: Use designated areas for construction parking to the extent available. Coordinate with Building Management and Owner. Make arrangements for off site parking for overflow.
- K. Cleaning: Maintain areas free of waste materials, debris, and rubbish. Clean site daily and leave in orderly condition.
 - 1. Arrange for daily trash and debris removal. Do not use building dumpsters unless permitted in writing by Owner.
 - 2. Do not allow flammable or hazardous materials or refuse to accumulate. Arrange for legal removal and disposal of flammable or hazardous materials.
 - 3. Comply with hauling and disposal regulations of authorities having jurisdiction.
- L. Removal of Utilities, Facilities, and Controls: Remove temporary utilities, equipment, facilities, and materials prior to Substantial Completion Application.
- M. Clean and repair damage caused by installation or use of temporary work at no additional expense to the Owner.

1.12 PRODUCT REQUIREMENTS

- A. Products: New materials, machinery, components, equipment, fixtures, and systems forming work, but does not include machinery and equipment used for preparation, fabrication, conveying, and erection of work. Use interchangeable components of the same manufacturer for similar components. Use new materials in the execution of the Work unless otherwise indicated.
- B. Transportation, Handling, Storage, and Protection: Transport, handle, store, and protect materials in accordance with manufacturer's instructions.

1.13 EXECUTION

- A. Existing Conditions: The existence and location of utilities, and construction indicated as existing are approximate. Prior to commencement of Work, investigate and verify existence and location of mechanical and electrical systems and other construction affecting the Work.
- B. Field Measurements: Take field measurements required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to adjacent construction, verify dimensions of construction by field measurements prior to fabrication. Coordinate fabrication schedule with construction progress to avoid delaying Work.
- C. Layout Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
 - 1. Lay out work to be performed. Provide and pay for construction layout work. Verify dimensions shown on the Drawings. Notify Architect in writing of discrepancies found before proceeding or continuing with the Work.
 - 2. During progress of the Work, establish additional benchmarks, reference lines and reference points and levels as necessary for the guidance and information of each trade and for the field verification of specified construction tolerances. Calculate and measure required dimensions within indicated or recognized tolerances.
 - 3. Locate work and components of the work accurately, in correct alignment and elevation, as indicated.
 - 4. Comply with manufacturer's written instructions and recommendations.
 - 5. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- D. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
- E. Mounting Heights: Where mounting heights are not indicated, mount components at heights compliant with ADAAG when applicable.
- F. Cutting and Patching:
 - 1. Employ skilled and experienced installer to perform cutting and patching new or existing work; restore using new materials.
 - 2. Submit written request in advance of cutting or altering structural or building enclosure elements.
 - 3. Fit Work tight to adjacent elements. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
 - 4. Refinish surfaces to match adjacent finishes.
 - 5. Restore to original or required fire and smoke ratings.

- G. Core Drilling: Perform core drilling of structural slabs to accommodate passage of pipe sleeves, ducts, conduit, or similar utility service lines through floors by trade requiring opening. Supervise patching holes and verify any core drilled hole through structural slab is fire stopped with approved firestopping complying with appropriate UL listing.
1. Notify Owner minimum 48 hours in advance of core drilling to obtain approval. Each day core drilling is required, obtain permission of the Owner and Building Management prior to commencement of core drilling. Comply with the following requirements:
 - a. Demonstrate effectiveness of ground fault safety device in stopping the drill when the bits contacts metal.
 - b. Investigate area where core drilling will occur to determine:
 - 1) the exact location of penetration on the ceiling below;
 - 2) the possibility of predictable conduit running through the slab or potential, foreseeable problems;
 - 3) obtain approval for drill bit coolant from Owner and Architect; and
 - 4) advise Owner and Architect of necessary precautions.
- H. Protection of Work: Protect existing and new work and equipment from damage. The Installing trade is responsible for the protection of its work until the work is complete and materials and apparatus have been tested and accepted. Obtain directions and continue protection of work after Installer is no longer on the job. Repair or replace damaged work.
1. Exercise care to prevent damage to existing Work, equipment, landscaping, fixtures, utilities, and similar items during construction period until Final Acceptance. Repair or replace damaged items or Work at no expense to Owner.
 2. Take responsibility for installed Work and arrange to protect Work, equipment, and materials in accordance with recommendations of manufacturer and installer. Cover Work, equipment, and materials to protect from dirt, construction dust, traffic, wear, and injury including damage from workmen. Repair or replace damaged Work.
 3. Promptly repair damage to work of other trades, existing conduits, ducts, drains, sewers, pipes, utilities, and similar items at the expense of the offending installer or trade.

1.14 CONSTRUCTION ENVIRONMENTAL QUALITY PROCEDURES

- A. Construction environmental requirements are general in nature, referencing requirements and Specification Sections for more detailed requirements. Notify Owner and Architect if conflicts arise between performance of the Work and environmental requirements.
1. Use resources efficiently; the construction, operation, and ultimate reuse or removal of the building components is optimized to eliminate unnecessary use of energy, water, and raw materials.

2. Provide healthy and productive indoor environment.
- B. Environmental Procedures: Minimize environmental impacts of construction activities and operations. Manage environmental quality through use of recycled materials, use of materials from sustainably managed forests, energy efficient equipment and fixtures, waste handling procedures, and limiting contaminants and irritants emitted into the air, soil, and waterways.
1. Environmental Quality:
 - a. Control sources of outdoor and indoor environmental pollutants.
 - b. Identify potential means of contaminant spread.
 - c. Identify reasonable control options for containing contaminants.
 2. Select materials and installation methods to maximize renewable resources, increase energy efficiency, minimize environmental pollution, and utilize recycled or recyclable materials.
- C. Indoor Environmental Quality: Comply with ASHRAE 62.1 to reduce indoor environmental quality issues resulting from contaminants during and after construction until date of Substantial Completion.
1. Avoid use of materials high in pollutants, such as volatile organic compounds (VOC) or toxins. In addition to VOC limitations specified for low emitting materials adhesive, sealants, and paint products, utilize materials and products complying with VOC content limitations.
 2. Avoid entrainment of pollutants into ventilation air path.
 3. Sufficiently ventilate enclosed areas.
 4. Protect organic matter and materials against mold, insect infestation, or absorption of odors.
 5. Sequence construction activities to prevent absorption of contaminants by building materials.
 6. Limit use of building ventilation system during construction activities.
 - a. Cover diffusers, registers, grilles, and open ducts during construction to prevent dust and odors from entering ventilation system.
 - b. Replace filtration media prior to date of Substantial Completion.
- D. Environmental Considerations: Protect natural, air, and water resources. Implement, monitor, and enforce environmental quality program during construction activities until date of Final Completion.
1. Employ methods of construction that responsibly use resources. Confine disposal operations for demolished and waste materials that are not identified for salvage, recycling, or reuse. Employ job site recycling and salvage procedures.
 2. Promote environmental quality including outdoor and indoor quality. Environmental quality includes light quality, acoustic quality, thermal comfort, and air quality.

- a. Utilize low emitting materials adhesive, sealants, and paint products. Maximize use of nontoxic, nonhazardous, healthy, and safe building materials.
 - b. Limit use of building ventilation system during construction activities. Should permanently installed air handlers be used during construction, utilize filtration media at each return air grille.
 - c. Maintain and prevent contamination of the air.
 - 1) Prevent creation of dust, air pollution, and odors.
 - 2) Use temporary enclosures and appropriate methods to limit dust and dirt rising and scattering in air to lowest practical level.
 - 3) Protect stored on site and installed absorptive materials from moisture damage.
 - 4) Store volatile liquids, including fuels and solvents, in closed containers.
 - 5) Maintain equipment to reduce gaseous pollutant emissions.
 - 6) Provide minimum 48 hour preventilation of packaged dry products prior to installation. Remove from packaging and ventilate in secure, dry, well ventilated space free from strong contaminant sources and residues. Provide temperature range of 60 deg F minimum to 90 deg F maximum continuously during ventilation period. Do not ventilate within limits of work unless approved by Owner.
 - d. Provide good ventilation during and after installation of interior wet products and interior final finishes
3. Control odors for construction activities, processing, and preparation of materials. For potentially noxious materials, identified and employ control measures complying with SMACNA guidelines.
- a. Smoking or tobacco materials are not permitted in building or within 25 feet of entrances, windows, or outdoor air intakes.
 - b. Use of gasoline or fuel fired equipment are not permitted inside enclosed building.
 - c. Keep wet processes within enclosed building to minimum.
 - d. Protect chase and gypsum board materials from water. Remove and replace damaged materials.
 - e. Use low emission materials and chemicals.
 - f. Perform cleaning involving chemicals outside building to the extent possible.
 - g. Unroll or uncrate carpet materials and air off site for minimum of minimum 3 days prior to installation.
 - h. Remove trash daily to the appropriate recycle container.
 - i. Treat mold growth according to the procedures recommended by the EPA.
 - j. Clean inside of walls at base track to remove excess materials and dirt with vacuum prior to enclosing wall.
 - k. HEPA vacuum concrete floors before installation of floor covering materials.
 - l. Do not enclose, hide, or paint over mold or chemical contamination.

4. Housekeeping and Pest Management Procedures:
 - a. Designate area for food storage and consumption. Immediately dispose of food or food residues after meals or breaks.
 - b. Minimize entry of dirt with walk off grilles or mats.
 - c. Inspect and clean coils, fans, and air handler chambers including return air chambers prior to start up, final testing, commissioning, and air testing.
5. Control hydrocarbons and carbon monoxide emissions from equipment to comply with federal, state, and local allowable limits. For potentially noxious materials, identified and employ control measures complying with SMACNA guidelines.
6. Isolate areas of Work necessary to prevent contamination of clean or occupied spaces. Provide pressure differentials or physical barriers to protect clean or occupied spaces.
7. Schedule construction operations involving wet and odorous materials and products prior to packaged dry products or odor absorbent materials and products to reduce absorption of VOCs by porous materials.
8. Promote conservation efficiencies in operational performance including but not limited to durability, maintainability, and energy and water efficiency.
9. Comply with federal, state, and local environmental regulations for wastes considered hazardous or toxic and requiring special disposition, including maintaining documentation.

1.15 CLOSEOUT PROCEDURES

- A. Closeout Procedures: Submit written certification that Contract Documents have been reviewed, Work inspected, and Work completed in accordance with the Contract Documents, and ready for Architect's inspection.
 1. Submit final application for Payment identifying total adjusted Contract Sum, previous payments, and remaining amount due.
- B. Final Cleaning: Execute final cleaning prior to final inspection.
 1. Clean interior and exterior surfaces exposed to view.
 2. Legally remove and dispose waste and surplus materials, rubbish, and construction facilities from site. Whenever possible, recycle construction wastes and debris.
- C. Adjusting: Adjust operating equipment and materials to ensure smooth and unhindered operations.
- D. Operation and Maintenance Data: Submit two sets prior to final inspection, bound in 8-1/2" x 11" text pages, three-ring hard cover binder. Provide an additional copy in electronic PDF format.

1. Provide one set of printed operating and maintenance instructions including oil and lubrication instructions, filter changes, fan belt adjustments, and similar items.
 2. Prepare binder cover with identification title and project name.
 3. Internally subdivide binder contents with permanent page dividers, logically organized by product division.
 4. Contents:
 - a. Directory listing names, addresses, and telephone numbers of Architect, Contractor, subcontractor, and major equipment suppliers.
 - b. Operation and maintenance instructions arranged by system.
 - c. Project document and certifications.
 - d. Shop drawings.
 - e. Product data.
 - f. Air and water balance reports.
 - g. Warranties.
- E. Warranties: Provide duplicate notarized copies. Execute and assemble document from subcontractors, suppliers, and manufacturers. Submit prior to final Application for Payment.
- F. Spare Parts and Maintenance Materials: Provide products, spare parts, maintenance, and extra materials in quantities specified in individual sections. Deliver to site and place in location directed. Obtain receipt prior to final payment.
- 1.16 PROJECT RECORD DOCUMENTS
- A. Maintain on site in office, one set of Contract Documents and Shop Drawings to be utilized for record documents. Record actual revisions to the work concurrent with construction progress.
- B. Submittal: Submit one hard copy set of marked up record prints and PDF electronic files of scanned marked up record drawings with comment function enabled. Plot each drawing file, whether or not changes and additional information were recorded. Submit documents to Architect with claim for final Application for Payment.
1. Prepare a full set of corrected drawings including, but not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Revisions to electrical circuitry.
 - d. Actual equipment locations.
 - e. Duct size and routing.
 - f. Locations of concealed internal utilities.
 - g. Changes made by Change Order. Note Change Order numbers, and similar identification as applicable.
 - h. Important additional information that was either shown schematically or omitted from original Drawings.

- i. Changes made following Architect's written orders.
- j. Details not on the original Contract Drawings.
- k. Field records for variable and concealed conditions.

1.17 STARTING AND ADJUSTING OF SYSTEMS

- A. Starting Systems: Provide notification minimum 7 days prior to start up of each system.
 - 1. Ensure each piece of equipment or system is ready for operations.
 - 2. Execute start up under supervision of responsible person in accordance with manufacturer's instructions.
 - 3. Submit written report stating equipment or system has been properly installed and is functioning correctly.
- B. Testing, Adjusting, and Balancing: Appoint, employ, and pay for services of independent firm to perform testing, adjusting, and balancing. Reports will be submitted by independent firm to Architect indicating observations and results of tests and indicating compliance with requirements.

1.18 SUSTAINABLE DESIGN REQUIREMENTS – EMBODIED CARBON

- A. Related Requirements:
 - 1. Environmental Product Declarations Reporting Form (00 60 00 "Project Forms").
 - 2. Individual sections with embodied carbon submittal requirements.
- B. Definitions and Standards:
 - 1. Embodied carbon is the amount of carbon dioxide equivalents resulting from the production, shipping, installation, use and disposal of a material.
 - 2. Environmental Product Declaration (EPD) is a standardized way of reporting the environmental impact of a product or system, including but not limited to embodied carbon. Products with EPDs in accordance with ISO 14025, ISO 21930, or EN 15804 can report a product's Global Warming Potential.
 - 3. Global Warming Potential (GWP) is the calculated value for tracking embodied carbon and is the amount of equivalent metric tons of carbon dioxide emitted as a result of the life-cycle of a material. GWP is reported by an EPD or LCA, and can be reported as total value, by subtotal value for each life-cycle stage, or by individual life-cycle modules:
 - a. Production Stage (modules A1-A3): GWP reported for this stage, also known as "cradle-to-gate," includes raw material supply (A1), transport of raw materials to the production site (A2), and manufacturing (A3).
 - 4. Life-Cycle Assessment (LCA) is a standardized way of quantifying the environmental impact of a product or system, including but not limited to embodied carbon. LCAs must be conducted in accordance with ISO 14044, and report a product's Global Warming Potential.

- C. Embodied Carbon Submittals: Where Embodied Carbon documentation is required by individual specification Sections, provide the specific EPD types indicated for the products listed in the Section. Document on the EPD Reporting Form included in Section 006000 "Project Forms."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 018133 - SUSTAINABLE DESIGN REQUIREMENTS - EMBODIED CARBON

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Related Requirements:
 - 1. Environmental Product Declarations Reporting Form (00 60 00 "Project Forms").
 - 2. Individual sections with embodied carbon submittal requirements.

1.2 SUMMARY

- A. This Section includes general requirements and procedures for complying with the Gensler Product Sustainability (GPS) Standards v2.0; and the Project's specific sustainable design goals.
 - 1. Reduction of the total embodied carbon of the project for the following materials categories:
 - a. Thermal and roofing insulation.
 - b. Non-Structural (interior) metal framing.
 - c. Gypsum board.
 - d. Sound attenuation blankets.
 - e. Acoustical panel ceilings.
 - f. Carpet tile.
- B. Related Requirements:
 - 1. Environmental Product Declarations Reporting Form.
 - 2. Individual sections with EPD and GWP submittal requirements.

1.3 DEFINITIONS AND STANDARDS

- A. Gensler Product Sustainability (GPS) Standards v2.0; represents the Architect's commitment to reducing carbon emissions in all of our projects by 2030. A critical step in that process is setting sustainability standards for the products that we specify.
- B. The Gensler Product Sustainability (GPS) v2.0 standards establish sustainability performance criteria for the top 19 most commonly used, high-impact product categories selected for our architecture and interior projects. These product categories include:

1. Acoustic Ceiling Panels, Tiles, and Suspension Grids.
 2. Batt Insulation.
 3. Board Insulation.
 4. Carpet Tile.
 5. Decorative Glass.
 6. Glass Demountable Partitions.
 7. Gypsum Board.
 8. Interior Latex Paint.
 9. Non-Structural Metal Framing.
 10. Resilient Flooring and Base.
 11. Systems Furniture Workstations.
 12. Task Chairs.
 13. Access Flooring.
 14. Broadloom Carpet.
 15. Hollow Metal Doors and Frames.
 16. Sandwich Panels (Europe/UK only).
 17. Textiles.
 18. Tiles.
 19. Wallcoverings.
- C. The intent of the Gensler Product Sustainability (GPS) Standards v2.0 is to provide clear and concise standards for our design teams; and material and product manufacturers built on industry norms.
- D. The criteria were developed in alignment with initiatives by industry organizations, regulatory standards, and third-party certifications. In particular, we are collaborating with mindful MATERIALS to align with the ongoing development of the Common Material Framework to ensure consistency across the industry for a unified ask for sustainability disclosures. The GPS Standards align with goals and criteria identified by the Carbon Leadership Forum, REACH, ISO, BIFMA, LEED, BREEAM, Living Building Challenge, and the AIA Materials Pledge among others.
- E. The inclusion of the Gensler Product Sustainability (GPS) Standards changes the way in which the Architect will select materials for inclusion as "Basis of Design" or "Listed Products" meeting the specified criteria. It also adjusts the requirements for material and product Submittals as described in the Division 01 General Requirement sections that follow.
- F. Embodied carbon is the amount of carbon dioxide equivalents resulting from the production, shipping, installation, use and disposal of a material.
- G. Environmental Product Declaration (EPD) is a standardized way of reporting the environmental impact of a product or system, including but not limited to embodied carbon. Products with EPDs in accordance with ISO 14025, ISO 21930, or EN 15804 can report a product's Global Warming Potential.

- H. Global Warming Potential (GWP) is the calculated value for tracking embodied carbon and is the amount of equivalent metric tons of carbon dioxide emitted as a result of the life cycle of a material. GWP is reported by an EPD or LCA, and can be reported as total value, by subtotal value for each life-cycle stage, or by individual life-cycle modules:
- I. Production Stage (modules A1-A3): GWP reported for this stage, also known as "cradle-to-gate," includes raw material supply (A1), transport of raw materials to the production site (A2), and manufacturing (A3).
- J. Life-Cycle Assessment (LCA) is a standardized way of quantifying the environmental impact of a product or system, including but not limited to embodied carbon. LCAs must be conducted in accordance with ISO 14044 and report a product's Global Warming Potential.

1.4 STANDARDS

- A. ISO 14044 Environmental Management Life Cycle Assessment.
- B. ISO 14025 Environmental Labels and Declarations.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Embodied Carbon Documentation:
 - 1. Compile and review all documentation required to support the Project's embodied carbon goals.
 - a. Collect and compile all required EPDs for products requiring embodied carbon documentation.

1.6 INFORMATIONAL SUBMITTALS

- A. General: Submit sustainable product design submittals as a component of combined technical/sustainability submittal as required by other Specification Sections. As noted in Section 013300 SUBMITTAL PROCEDURES, combined submittals are required; review of separated individual technical and sustainability submittals will not be accepted.
- B. Sustainable Design Submittals:
 - 1. Embodied Carbon Documentation:
 - a. The EPD Reporting Form included in Section 006000 "Project Forms" is required for product category listed below. If a system is specified, each product in the system must be counted separately.

- b. Provide the Product-Specific or Industry-Wide Type III EPD in compliance with ISO 14025 or LCA for each product specified, with specific emphasis on the following product categories:
- 1) Thermal and roofing insulation.
 - 2) Non-structural (interior) metal framing.
 - 3) Gypsum board.
 - 4) Sound attenuation blankets.
 - 5) Acoustical panel ceilings.
 - 6) Carpet tile.
 - 7) Access Flooring.
 - 8) Broadloom Carpet.
 - 9) Hollow Metal Doors and Frames.
 - 10) Sandwich Panels (Europe/UK only).
 - 11) Textiles.
 - 12) Tiles.
 - 13) Wallcoverings.
- c. For products in which an EPD or LCA is not available, provide a dated written confirmation on manufacturer's letterhead that an EPD or LCA is not available for the product at time of product submission.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes demolition and removal of specific portions of building.

1.2 MATERIALS OWNERSHIP

- A. Materials Ownership: Unless otherwise indicated, demolition waste becomes property of Contractor. Materials to be reused remain the property of the Owner.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.4 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. It is not expected that hazardous materials will be encountered in the Work. 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. Maintain fire-protection facilities in service during selective demolition operations.

PART 2 - PRODUCTS

2.1 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 ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Maintain existing utilities/services/systems indicated to remain and protect them against damage.
- B. Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
- C. Owner will arrange to shut off indicated services/systems when requested by Contractor. Provide minimum 48 hours notice when requesting shut-off.
- D. 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.
- E. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.

3.2 PROTECTION

- A. Protect construction indicated to remain against damage and soiling during selective demolition. 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.

3.3 SELECTIVE DEMOLITION, GENERAL

- A. Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 - 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.

4. Maintain adequate ventilation when using cutting torches.
5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
6. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
7. When cutting concrete, masonry, wallboard and any other dust-producing materials, provide temporary barriers to prevent spread of dust into the rest of the building. Provide filters for mechanical systems and air ducts.
8. Dispose of demolished items and materials promptly.

3.4 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS AND PRODUCTS

- A. Resilient Floor Covering and Glued-Down Carpets: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.
- B. Ballasts: If ballast is not labeled "No PCBs," or if the label is illegible, contact a ballast recycler for disposal.
- C. Mercury-Containing Devices: Mercury-containing devices include thermostats, silent switches, mechanical switches and relays or contacts. Dispose of these devices with an appropriate recycler.
- D. Nickel-Cadmium and Lead-Acid Batteries: Exit signs, emergency lighting units, alarm systems, smoke detectors, and carbon-monoxide detectors may contain nickel-cadmium or lead-acid. Arrange with an appropriate recycler for disposal.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. 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. Do not allow demolished materials to accumulate on site. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

3.6 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 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for concrete construction as shown in the drawings.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
 - 2. Submit substantiating data for each concrete mix design contemplated for use to the Architect no less than four weeks prior to first concrete placement. Data for each mix shall include the following:
 - a. Mix identification number (unique for each mix submitted).
 - b. Statement of intended mix use.
 - c. Mixture proportions.
 - d. Water/cementitious materials ratio.
 - e. Wet and dry unit weight.
 - f. Total air content.
 - g. Design slump and allowable range after additions of all admixtures.
 - h. Time limits on discharge: If time of discharge exceeds ACI 301 90 minute time limit, submit concrete properties criteria at permissible time of discharge and additional special inspection and testing requirements associated with time limits.

i. Compressive strength tests.

- C. Before submitting concrete design mixtures to the architect for review, contractor shall review concrete design mixture for applications, state on the submittal where the concrete mix will be used, establish procedures for ensuring quality of concrete materials and verify suitability of mix design for placement and finishing.
- D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, bent bar diagrams, bar arrangement, splices and laps, and supports for concrete reinforcement.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Curing compounds.
 - 6. Bonding agents.
 - 7. Vapor retarders.
 - 8. Repair materials.
 - 9. Supplementary Cementitious materials.
- B. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates: Submit test reports indicating that aggregates are not potentially reactive based on the ASTM C295 or ASTM 1260 testing limits set forth in section 5.1 of “Guide Specification for Concrete Subject to Alkali-Silica Reactions” (2007 Portland Cement Association). Alternatively, submit ASTM C1567 test reports indicating that the combination of mix ingredients reduces the expansion due to Alkali aggregate reactivity such that the mix complies with section 5.2 of “Guide Specification for Concrete Subject to Alkali-Silica Reactions” (2007 Portland Cement Association). All tests for submitted reports shall have been performed within one year of the submittal date.
- C. Minutes of preinstallation conference.
- D. Placement Notification: Submit notification to Architect at least 24 hours in advance of placement.
- E. Curing compound data demonstrating specified moisture loss performance.

1.6 QUALITY ASSURANCE

- A. 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.
- B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
 - 3. Personnel inspecting concrete reinforcing steel have current certification as an ACI Concrete Construction Inspector or have experience in concrete construction acceptable to the Architect.
- C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- D. 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."
- E. Preinstallation Conference: Conduct conference at Project site [or by video conference call].
 - 1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Ready-mix concrete manufacturer.
 - c. Concrete subcontractor.
 - d. Special concrete finish subcontractor.
 - e. Owner's Testing/Inspection Agency.
 - f. Engineer by video call
 - g. Architect by video call
 - 2. Review as applicable to Project special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, curing procedures, anchor rod and anchorage device installation tolerances, steel reinforcement installation, methods for achieving floor and slab flatness and levelness, floor and slab flatness and levelness measurement, concrete repair procedures, concrete protection, field sampling procedures for concrete cylinders and air testing, initial curing and field curing of field test cylinders (ASTM C31/C31M), protection of field cured field test cylinders.

3. Minutes of the meeting shall be recorded by Contractor and distributed to all parties within five days. Provide one copy to Owner's representative and Architect.
- F. Record of Work: Maintain a record listing time and date of all structural concrete placement. Such record shall be kept until completion of Project and shall be available to Architect for examination at any time.
- G. Pre-Placement Inspection: Formwork installation, reinforcing steel placement and installation of all items to be embedded or cast into concrete shall be verified by Contractor prior to placement.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement if present.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Total recycled content not less than 95 percent.
- B. All steel reinforcement shall be produced using an electric arc furnace.
- C. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

2.2 REINFORCEMENT ACCESSORIES

- A. 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," of greater compressive strength than concrete and as follows:

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 1. Ordinary Portland Cement: ASTM C 150, Type as indicated on drawings, gray
 2. Supplementary Cementitious Materials (SCM): Of proportions and type to meet concrete performance criteria as indicated in the structural drawings. Available SCM's that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fly Ash: ASTM C 618, Class F or C
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
 - c. Silica Fume: ASTM C 1240, amorphous silica.

- B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials. All coarse and fine aggregate shall be tested per ASTM C 295 or ASTM C 1293 in accordance with section 5.1 of "Guide Specification for Concrete Subject to Alkali-Silica Reactions" (2007 Portland Cement Association).
1. Maximum Coarse-Aggregate Size: As indicated on Drawings.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable or ASTM C 1602 tested non-potable which is compatible with admixtures. [Provide sample and obtain approval from architect of color and finish of exposed concrete mixes where non-potable water is used.]

2.4 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- 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.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
 7. Mid-Range Water Reducing Admixture: ASTM C 494/C 494M, Type A.

2.5 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. VOC Content: Evaporation retarders shall have a VOC content of 780 gram/Liter or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Axim Italcementi Group, Inc.; CATExOL CimFilm.
 - b. BASF Construction Chemicals - Building Systems; Confilm.
 - c. ChemMasters; SprayFilm.
 - d. Conspec by Dayton Superior; Aquafilm.

- e. Dayton Superior Corporation; Sure Film (J-74).
 - f. Edoco by Dayton Superior; BurkeFilm.
 - g. Euclid Chemical Company (The), an RPM company; Eucobar.
 - h. Kaufman Products, Inc.; Vapor-Aid.
 - i. Lambert Corporation; LAMBCO Skin.
 - j. L&M Construction Chemicals, Inc.; E-CON.
 - k. Meadows, W. R., Inc.; EVAPRE.
 - l. Metalcrete Industries; Waterhold.
 - m. Nox-Crete Products Group; MONOFILM.
 - n. Sika Corporation; SikaFilm.
 - o. SpecChem, LLC; Spec Film.
 - p. Symons by Dayton Superior; Finishing Aid.
 - q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
 - r. Unitex; PRO-FILM.
 - s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 ounce./sq. yard. 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. Film must chemically break down in a four to six week period. Membrane-Forming Curing Compounds shall have a VOC content of 350 gram/Liter or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A. Curing and sealing Compounds shall have a VOC content of 350 gram/Liter or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 RELATED MATERIALS

- A. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.7 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
- 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 4. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.8 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
1. Use a qualified testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Supplementary Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement while meeting the embodied carbon limits listed on the drawings. Where indicated on the drawings, limit percentage, by weight, of cementitious materials other than Portland cement in concrete.
- C. Limit water-soluble, chloride-ion content in hardened concrete as listed on the drawings.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

2.9 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Proportion structural normal-weight concrete mixture as noted on Drawings, unless aggregates are “potentially reactive” with alkalis based on the ASTM C 295 or ASTM C 1260 or ASTM C 1293 testing limits of Section 5.1 of “Guide Specification of Concrete Subject to Alkali-Silica

Reactions" (2007 Portland Cement Association). When aggregates are "potentially reactive", compliance with Section 5.2 of "Guide Specification for Concrete Subject to Alkali-Silica Reactions" (2007 Portland Cement Association) must be established through ASTM C 1567 testing for proposed alternate concrete mixture. Submit test reports in accordance with Part I of this Specification.

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 ASTM C 1116/C 1116M, and furnish batch ticket information.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cubic yard. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 1 cubic yard. increase mixing time by 15 seconds for each additional 1 cubic yard.
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.
- D. Size, length, number and placement of supports shall be sufficient as to maintain reinforcing position within specified tolerances during construction traffic and concrete placement.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.2 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. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- C. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.3 FINISHING FORMED SURFACES

- A. 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.

3.4 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

3.5 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

3.6 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. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- 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 with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape. Moisture-retaining-cover shall be inspected each day by Contractor. Any areas which do not show condensation on underside of cover or any slab areas which are not wet shall be immediately rewetted and cover replaced to prevent moisture loss.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 - 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.
 - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.7 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.

- B. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Submit proposed repair to Architect for review prior to commencement of work.
1. Repair finished surfaces containing defects that are unacceptable to Architect. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.031 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- C. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- D. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.8 FIELD QUALITY CONTROL

- A. Testing and Inspection: As indicated on Drawings.

3.9 JOBSITE TESTING AND INSPECTION REQUIREMENTS FOR CONCRETE

- A. Cast-in-Place Concrete Inspection and Testing – Before Concrete Placement
1. Formwork Dimensional Layout.

- a. Type 2: Site inspection for Layout and Quantities.
 - b. Criteria: Prior to placement of concrete inspect formwork of first pour of each type (grade beam, column, structural slab, slab-on-deck, etc.).
 - c. Frequency: (P) Periodic inspection.
 - d. Standard: ACI 301-16 2.2-2.3
 2. Reinforcing Steel Placement.
 - a. Type 2: Site inspection for Layout and Quantities.
 - b. Criteria: Verify grade, finish, size, bar quantity, location, spacing, cover, hook lengths, splice lengths, splice locations, bend diameters, coating, surface conditions, and supports.
 - c. Frequency: 100% observation / testing. Continuous inspection required for special moment frames per ACI 318 26.13.3.2
 - d. Standard: ACI 301-16 3.2-3.3.
- B. Cast-in-Place and Concrete Inspection and Testing – During Concrete Placement.
 1. Verify Design Mix.
 - a. Type 1: Material Verification and Workman Certifications.
 - b. Criteria: Verify use of approved design mixture for each truck load.
 - c. Frequency: 100% observation / testing. IBC only requires periodic inspection.
 - d. Standard: ACI 318 Ch. 19, 26.4.3, 26.4.4.
 2. Concrete Placement Inspection.
 - a. Type 3: Site Inspection for Procedures and Workmanship.
 - b. Criteria: Inspect placement of concrete per standard (see below).
 - c. Frequency: (C) Continuous inspection.
 - d. Standard: ACI 301-16 5.3.2.
 3. Concrete Curing Inspection.
 - a. Type 3: Site Inspection for Procedures and Workmanship.
 - b. Criteria: Inspect curing of concrete per standard (see below).
 - c. Frequency: (P) Periodic inspection.
 - d. Standard: ACI 301-16 5.3.6.
- C. Structural Concrete Testing.
 1. Note: Nondestructive testing may be permitted by the architect but will not be used as sole basis for approval or rejection of deficient concrete.
 2. Composite Concrete Sample – $f'_c < 5000$ PSI.
 - a. Type 4: Site Testing for Material Properties and Workmanship.
 - b. Criteria: Obtain sample at point of placement. For drilled piers obtain near beginning of load prior to placement in shaft.
 - c. Frequency: At least once a day or at least once for each 100 cubic yards of concrete or at least once for each 5,000 square feet of surface area for slabs and walls. Adjust frequency as required to provide minimum 5 total tests per mix but not more than one sample per truck load.
 - d. Standard: ASTM C172.
 3. Slump/Slump Flow.
 - a. Type 4: Site Testing for Material Properties and Workmanship.
 - b. Criteria: Specified slump shall be as submitted in the mix design $\pm 1 \frac{1}{2}$ ". perform additional tests when concrete consistency appears to change.
 - c. Frequency: Each composite sample (see above).
 - d. Standard: ASTM C143 (slump) or ASTM C1611 (slump flow).
 4. Compressive Strength.

- a. Type 4: Site Testing for Material Properties and Workmanship.
 - b. Criteria: Reports of compressive strength tests shall contain the following information: date of concrete placement, location of concrete batch in work, design 28-day compressive strength, concrete supplier and mixture ID number, time of batch and placement, ambient air temperature, site added water and admixtures, unit weight, and as required by ASTM C39. Acceptance criteria per ACI 318.
 - c. Frequency: Test per schedule below:
 - 1) 7 days: 6x12 or 4x8
 - 2) 28 days: 6x12 or 4x8
 - 3) 56 days: 6x12 or 4x8 (if 28 day tests do not achieve specified 28 day strength).
 - d. Standard: ASTM C31, ASTM C39. Either 6x12 or (6) 4x8 cylinders.
- D. Expansion, Sleeve and Screw Anchor Inspection and Testing – Before Anchor Installations
- 1. Verify Installation Procedure.
 - a. Type 1: Material Verification and Workman Certifications.
 - b. Criteria: Review contractor's installation procedure.
 - c. Frequency: 100% observation / testing.
 - d. Standard: ICC-ES Report.
 - 2. Verify Anchor Type, Diameter, and Materials.
 - a. Type 2: Site Inspection for Layout and Quantities.
 - b. Criteria: Verify anchor products to be used for compliance of anchor type, diameter, materials and product
 - c. Frequency: 100% observation / testing.
 - d. Standard: ICC-ES Report.
 - 3. Verify Max Allowed Impact Wrench Torque.
 - a. Type 3: Site Inspection for Procedures and Workmanship.
 - b. Criteria: For screw anchors, confirm the maximum allowed impact wrench torqued as defined by the manufacturer.
 - c. Frequency: (C) Continuous inspection.
 - d. Standard: ICC-ES Report.
- E. Expansion, Sleeve and Screw Anchor Inspection and Testing – During Anchor Installations
- 1. Continuous inspection required regardless if periodic inspection is permitted by ICC-ES report.
 - 2. Verify Hole Layout.
 - a. Type 2: Site inspection for Layout and Quantities.
 - b. Criteria: Verify the hole layout matches the contract documents. Review of layout should include number of anchors, spacing, edge distances, and quantity.
 - c. Frequency: (C) Continuous inspection.
 - d. Standard: ICC-ES Report.
 - 3. Verify Hole Diameter, Depth, Cleaning
 - a. Type 2: Site inspection for Layout and Quantities.
 - b. Criteria: Verify the hole diameter and depth meet the manufacturer requirements and the requirements shown on the contract documents. Observe the hole cleaning procedure is in accordance with the anchor manufacturers recommendations.
 - c. Frequency: (C) Continuous inspection.
 - d. Standard: ICC-ES Report.
 - 4. Verify Anchor Installation.
 - a. Type 3: Site Inspection for Procedures and Workmanship.

- b. Criteria: Verify the anchor installation of the anchor is in accordance with the anchor manufacturer recommendations.
 - c. Frequency: (C) Continuous inspection.
 - d. Standard: ICC-ES Report.
- F. Expansion, Sleeve and Screw Anchor Inspection and Testing – After Anchor Installations
 - 1. Verify Installation of Attached Assembly.
 - a. Type 3: Site Inspection for Procedures and Workmanship.
 - b. Criteria: Verify number, edge distances, and anchor flush with and perpendicular to the receiving surface.
 - c. Frequency: (C) Continuous inspection.
 - 2. Torque Test Anchors.
 - a. Type 4: Site Testing for Material Properties and Workmanship.
 - b. Criteria: Test anchor with calibrated torque wrench to 100% of the installation torque noted in ICC-ES report. Attain specified torque within 1/2 turn of the nut.
 - c. Frequency: 100% observation / testing.
 - d. Standard: ICC-ES Report.
- G. Adhesive Anchors and Reinforcing Inspection and Testing - Before Anchor / Reinforcing Installation
 - 1. Verify Installation Procedure.
 - a. Type 1: Material Verification and Workman Certifications.
 - b. Criteria: Review contractor's installation procedure. Verify adhesive to be used for product type, manufacturer recommendations, expiration dates, pot life, working temperature ranges for adhesives, substrates and anchors.
 - c. Frequency: 100% observation / testing.
 - d. Standard: ICC-ES Report.
 - 2. Verify Anchor Type, Diameter and Materials.
 - a. Type 2: Site inspection for Layout and Quantities.
 - b. Criteria: Verify anchor to be used for compliance of anchor type, diameter, length, finish, and base material. Verify solid grouted area around anchors in grouted masonry
 - c. Frequency: 100% observation / testing.
 - d. Standard: ICC-ES Report.
- H. Adhesive Anchors and Reinforcing Inspection and Testing - During Anchor/Reinforcing Installation
 - 1. Continuous inspection required regardless if periodic inspection is permitted by ICC-ES report.
 - 2. Verify Hole Layout.
 - a. Type 2: Site inspection for Layout and Quantities.
 - b. Criteria: Verify the hole layout matches the contract documents. Review of layout should include number of anchors, spacing, edge distances, and quantity.
 - c. Frequency: (C) Continuous inspection.
 - d. Standard: ICC-ES Report.
 - 3. Verify Hole Diameter, Depth and Cleaning.
 - a. Type 2: Site inspection for Layout and Quantities.
 - b. Criteria: Verify the hole diameter and depth meet the manufacturer requirements and the requirements shown on the contract documents. Observe the hole cleaning procedure is in accordance with the adhesive manufacturer's recommendations.

- c. Frequency: (C) Continuous inspection.
 - d. Standard: ICC-ES Report.
 - 4. Verify Anchor Installation.
 - a. Type 3: Site Inspection for Procedures and Workmanship.
 - b. Criteria: Verify the anchor installation of the anchor is in accordance with the adhesive manufacturer's recommendations. Verify the temperatures of the adhesive, substrate and anchors are within the manufacturer recommended ranges.
 - c. Frequency: (C) Continuous inspection.
 - d. Standard: ICC-ES Report.
- I. Adhesive Anchors and Reinforcing Inspection and Testing - After Anchor / Reinforcing Installation
 - 1. Verify Installation of Attached Assembly.
 - a. Type 3: Site Inspection for Procedures and Workmanship.
 - b. Criteria: Verify number, edge distances, and anchor flush with and perpendicular to the receiving surface. Verify full cure time has elapsed prior to application of torque or load to anchor.
 - c. Frequency: (C) Continuous inspection.

END OF SECTION 033000

SECTION 035416 - HYDRAULIC CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes cement-based and calcium aluminate based, polymer-modified, self-leveling underlayment for interior finish flooring.

1.2 COORDINATION

- A. Coordinate cement-based underlayment with requirements of finish flooring products, including adhesives, specified in Division 09 Sections.
 - 1. Before installing surface sealers, if recommended by underlayment manufacturer, verify compatibility with finish flooring installation adhesives.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Installer who is approved by manufacturer and factory trained for application of underlayment products required for this Project.
- B. Product Compatibility: Manufacturers of underlayment and floor covering systems certify in writing that products are compatible.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.
 - 1. Place hydraulic-cement-based underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F (10 and 27 deg C).

PART 2 - PRODUCTS

2.1 HYDRAULIC-CEMENT-BASED UNDERLAYMENTS

- A. Underlayment: Portland cement-or calcium aluminate based, polymer-modified, products complying with ASTM C 1708/C 1708M and that can be applied in thicknesses required for conditions indicated and that can be tapered to a maximum height of 1/8-inch at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150/C 150M, Portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.
 - 2. Compressive Strength:
 - a. Self-Leveling Grade: Not less than 4000 psi (27 MPa) at 28 days when tested according to ASTM C 109/C 109M.
 - b. Trowel Grade: Not less than 4000 psi (27 MPa) at 28 days when tested according to ASTM C 109/C 109M.
- B. Manufacturers and Products: One of the following:
 - 1. Ardex, Inc.
 - a. Self-Leveling: K-15 Self-Leveling Underlayment Concrete.
 - b. Trowel Grade: Feather Finish or SD-P Instant Patch.
 - 2. Hi-Tech; MB10.
 - 3. Mapei; Novaplan 2 Plus.
 - 4. Uzin; NC 150, 170 or 172.
- C. Water: Potable and at a temperature of not more than 70 deg F (21 deg C).
- D. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.
- E. Surface Sealer: Designed to reduce porosity as recommended by manufacturer for type of floor covering to be applied to underlayment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Use a 10 foot (3 m) straightedge to check floor flatness.
- B. Mark with a pencil areas where flatness tolerances exceed 1/8 inch (3 mm) over a 10 foot (3 m) span.

- C. Examine substrates, with Installer present, for conditions affecting performance of underlayment including substrate moisture content. Begin underlayment application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare and clean substrates indicated to receive underlayment according to manufacturer's written instructions. Provide clean, dry, neutral-pH substrate for underlayment application.
 - 1. Treat nonmoving substrate cracks with a crack filler or elastomeric compound in accordance with the manufacturer's written instructions.
- B. Concrete Substrates: Mechanically remove laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, existing flooring adhesive residues, existing paint droppings, and other contaminants that might impair underlayment bond according to the underlayment manufacturer's written instructions.
- C. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

3.3 APPLICATION

- A. General: Mix and apply underlayment components according to manufacturer's written instructions.
 - 1. Coordinate application of components, including primer, to provide optimum underlayment-to-substrate and intercoat adhesion.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Apply underlayment to produce uniform, surface that is completely flat at areas indicated to receive self leveling type underlayment.
 - 1. Flatness Tolerance: Do not exceed 1/4 inch (6 mm) over a 10 foot (3 m) span.
 - 2. Maximum Height of Ridges: 1/16 inch (1.5 mm).
 - 3. Apply a final layer without aggregate if required to produce smooth surface.
 - 4. Feather edges as required for smooth transitions to adjacent floor elevations.
- D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.
- E. Do not install finish flooring over underlayment until after time period recommended by underlayment manufacturer.
- F. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 PROTECTION

- A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
- B. Related Sections:
 - 1. Section 014000 "Quality Requirements" for independent testing agency procedures and administrative requirements.

1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 PERFORMANCE REQUIREMENTS

- A. Connections:
 - 1. Provide connections as shown or noted on Drawings. Design of connections not shown or noted shall be provided by Structural Engineer-of-Record upon request.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop and Erection Drawings: Show location, fabrication, and assembly of structural-steel components.
 - 1. Location of each piece or detail within the structure.
 - 2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 3. Include embedment piece and setting drawings.
 - 4. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
 - 5. Indicate type, size, and length of bolts, distinguishing between shop and field bolts.

6. Drawings submitted in multiple packages shall contain individual submittals complete with all applicable erection drawings, details, and piece drawings.
 7. Reproduction of Contract Documents is not permitted.
 8. Provide schedule for submittal of shop and erection drawings.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and fabricator
- B. Welding certificates.
- C. Mill test reports for structural steel, including chemical and physical properties and steel mill of origin.
1. For structural steel products that are manufactured in a different facility than where the raw material is produced, the mill test report or separate letter included with the report shall clearly indicated the location of both facilities.
 2. If structural steel elements are sourced from multiple facilities, mill test reports shall be provided for each facility with a statement outlining the applicability of each report submitted.
- D. Product Test Reports: For the following if present on project:
1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 2. Shop primers.
- E. Fabricator qualifications: Provide written documentation from the fabricator summarizing their commitment to sustainable practices as outlined in Part 2 – Products.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- C. Field Painting Applicators: Qualified according to SSPC-QP1, "Standard Procedure for Evaluating Qualifications of Painting Contractors "Field Application to Complex Structures".
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- E. Comply with applicable provisions of the following specifications and documents:

1. AISC 303 -2022 as amended below:
 - a. Section 3.3: Replace entire section with the following: "Requirements for structural steel including quantities, sizes, locations, arrangement, and details shall be shown or noted in the overall Contract Drawing package. Fabricator is responsible for incorporating all such information from structural, architectural, mechanical, and electrical drawings, as well as those of other disciplines."
 - b. Section 3.6: Remove all text after first sentence.
 - c. Section 3.2.2: Replace entire section with the following: "When alternative delivery methods are implemented, release of structural drawings shall constitute release for construction only if specifically noted as such on the drawing. Drawing indicated "preliminary" or "not for construction" shall not be used for detailing or construction except where the risk of any cost or delay associated with subsequent revisions to Contract Documents is accepted by the Owner, Contractor or Fabricator."
 - d. Section 4.4: Revise second sentence to read the following: "The shop and erection drawings shall be returned in accordance with the schedule defined in Division 1 of the project Specification. In the absence of such schedule, the Owner's Designated Representative for Design shall return submittals within 14 calendar days of receipt from the Owner's Designated Representative for Construction."
2. AISC 360.
3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

F. Preinstallation Conference: Conduct conference at Project site.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.9 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. Supply structural steel materials produced and manufactured in the United States of America or Canada for all elements listed in this section.
- B. Angles: As indicated on Drawings.
- C. Plate and Bar: As indicated on Drawings.
- D. Welding Electrodes: Comply with AWS requirements, 70 Series
 - 1. Conform to Charpy V-Notch test requirements of AISC 360.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. Expansion Anchors, Screw Anchors, and Adhesive Anchors: Size and Manufacturer as indicated on Drawings. Complete assemblies with required rods, nuts, washers, and adhesive system as applicable. Installed in accordance with Manufacturer's installation instructions. Current ICC approval and published ICC Research Report required.
 - 1. Finish for use in conditioned environments free from potential moisture (interior): Plain or in accordance with Manufacturer's standard.

2.3 PRIMER

- A. Primer: Where steel is to be field painted, provide fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.4 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
 - 1. Mark and match-mark materials for field assembly.
 - 2. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations, if applicable.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

- C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces. Do not enlarge bolt holes by burning.
- D. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning or SSPC-SP 3, "Power Tool Cleaning."
- E. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
 - 1. Cut, drill, thermal cut, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
- F. Substitutions: Where exact sizes and weights indicated on Drawings are not readily available, secure approval of alternate sizes from Structural Engineer-of Record in time to prevent project delay.

2.5 SHOP CONNECTIONS

- A. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.6 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces to be field welded, including top flange of beams to receive steel headed stud anchors.
 - 2. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 3. Surfaces not otherwise indicated to be painted that are not exposed to view or weather in the final condition.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to either of the following specifications and standards:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of **1.5 mils (0.038 mm)**. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection.

2.7 SOURCE QUALITY CONTROL

- A. Testing and Inspection: As indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel Erector present, elevations of concrete bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
 - 1. Coordinate installation of non-structural steel items that load the temporarily supported steel frame such that temporary supports are adequate to resist all imposed loads.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- C. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
- D. Do not use thermal cutting during erection unless approved by Structural Engineer-of-Record. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- E. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.5 FIELD QUALITY CONTROL

- A. Testing and Inspection: As indicated on Drawings.

3.6 REPAIRS AND PROTECTION

- A. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" Section 099123 "Interior Painting."

3.7 JOBSITE TESTING AND INSPECTION REQUIREMENTS FOR STEEL

- A. Steel Testing and Inspection Definitions.
 - 1. UT – Ultrasonic Testing.
 - 2. MT – Magnetic Particle Testing.
 - 3. PT – Penetration Testing.
 - 4. SFRS – Seismic Force Resisting System.
 - 5. TTT – Tension Through Thickness.
- B. Steel Framing – General.
- C. Prior to Welding.
 - 1. Verify welder qualifications and ID system.
 - a. Type 1: Material Verification and Workman Certifications.
 - b. Criteria: Review manufacturer certifications for welding consumables and welding procedure specifications. Verify welder identification system. Note: The fabricator or erector, as applicable, shall maintain a system by which a welder who has welded a joint or member can be identified. Stamps, if used, shall be the low-stress type.
 - c. Frequency: (C) Continuous inspection.
 - d. Standard: AISC 360, Chapter N.
 - 2. Verify WPS available.
 - a. Type 1: Material Verification and Workman Certifications.
 - b. Criteria: Verify Welding Procedure Specification available.
 - c. Frequency: (C) Continuous inspection.
 - d. Standard: AISC 360, Chapter N.
 - 3. Verify base material and weld material.
 - a. Type 1: Material Verification and Workman Certifications.
 - b. Criteria: Verify base material and weld material are in conformance with approved documents.
 - c. Frequency: (P) Periodic inspection.

- d. Standard: AISC 360, Chapter N.
 - 4. Verify weld procedures and weld equipment.
 - a. Type 1: Material Verification and Workman Certifications.
 - b. Criteria: Verify weld procedures and weld equipment are in conformance with approved documents.
 - c. Frequency: (C) Continuous inspection.
 - d. Standard: AISC 360, Chapter N.
 - 5. Verify joint fit-up, prep, backing, etc.
 - a. Type 2: Site Inspection for Layout and Quantities.
 - b. Criteria: Verify fit up of groove welds (including joint geometry) meet requirements for joint preparation, dimensions (alignment, root opening, root face, bevel), cleanliness (condition of steel surfaces), tacking (tack weld quality and location), and backing type and fit (if applicable). Verify fit up of fillet welds meet requirements for dimensions (alignment, gaps at root), cleanliness (condition of steel surfaces), and tacking (tack weld quality and location). Verify configuration and finish of access holes.
 - c. Frequency: (P) Periodic inspection.
 - d. Standard: AISC 360, Chapter N.
- D. During Welding.
 - 1. Use of qualified welders.
 - a. Type 1: Material Verification and Workman Certifications.
 - b. Criteria: Verify welder certifications.
 - c. Frequency: (P) Periodic Inspection.
 - d. Standard: AISC 360, Chapter N.
 - 2. Handling of welding consumables.
 - a. Type 3: Site Inspection for Procedures and Workmanship.
 - b. Criteria: Verify proper control and handling of welding consumables including packaging and exposure control.
 - c. Frequency: (P) Periodic inspection.
 - d. Standard: AISC 360, Chapter N.
 - 3. No welding over cracked tack welds.
 - a. Type 3: Site Inspection for Procedures and Workmanship.
 - b. Criteria: Verify no welding over cracked tack welds.
 - c. Frequency: (P) Periodic inspection.
 - d. Standard: AISC 360, Chapter N.
 - 4. Verify WPS followed.
 - a. Type 3: Site Inspection for Procedures and Workmanship.
 - b. Criteria: Verify use of qualified welders. Verify Welding Procedure Specification is followed for settings on welding equipment, travel speed, selected welding materials, shielding gas type/flow rate, preheat applied, interpass temperature maintained (minimum and maximum), proper position (F, V, H, OH).
 - c. Frequency: (P) Periodic inspection.
 - d. Standard: AISC 360, Chapter N.
 - 5. Welding techniques.
 - a. Type 3: Site Inspection for Procedures and Workmanship.
 - b. Criteria: Verify proper welding techniques for single and multi-pass welds (interpass and final cleaning, each pass within profile limitations, each pass meets quality requirements).
 - c. Frequency: (P) Periodic inspection.

- d. Standard: AISC 360, Chapter N.
- E. After Welding.
- 1. Verify welds cleaned.
 - a. Type 3: Site Inspection for Procedures and Workmanship.
 - b. Criteria: Verify welds cleaned in accordance with standard.
 - c. Frequency: (P) Periodic inspection.
 - d. Standard: AISC 360, Chapter N.
 - 2. Verify weld size, length and location.
 - a. Type 3: Site Inspection for Procedures and Workmanship.
 - b. Criteria: Verify weld size, length and location conform to approved documents.
 - c. Frequency: (C) Continuous inspection.
 - d. Standard: AISC 360, Chapter N.
 - 3. Welds meet visual acceptance criteria.
 - a. Type 3: Site Inspection for Procedures and Workmanship.
 - b. Criteria: Verify welds meet visual acceptance criteria for crack prohibition, weld/base metal fusion, crater cross section, weld profiles, weld size, undercut, and porosity. Where inspector observes questionable welds, non-destructive testing shall be performed.
 - c. Frequency: (C) Continuous inspection.
 - d. Standard: AISC 360, Chapter N, AWS D1.1.
 - 4. Arc strikes.
 - a. Type 3: Site Inspection for Procedures and Workmanship.
 - b. Criteria: Verify no arc strikes are present in the base material. Arc strikes shall be tested using non-destructive methods and repaired if necessary.
 - c. Frequency: (C) Continuous inspection.
 - d. Standard: AISC 360, Chapter N.
 - 5. Verify no cracking in k-areas and at weld access holes.
 - a. Type 3: Site Inspection for Procedures and Workmanship.
 - b. Criteria: When welding of doubler plates, continuity plate, or stiffeners has been performed in the k-area, visually inspect the web k-area for cracks within 3 inches of the weld.
 - c. Frequency: (C) Continuous inspection.
 - d. Standard: AISC 360, Chapter N.
 - 6. Repair activities.
 - a. Type 3: Site Inspection for Procedures and Workmanship.
 - b. Criteria: Verify repair activities conform to standard. Backing and weld tabs removed, and fillet welds added where required.
 - c. Frequency: (C) Continuous inspection.
 - d. Standard: AISC 360, Chapter N.
 - 7. Document acceptance/rejection of joints.
 - a. Type 3: Site Inspection for Procedures and Workmanship.
 - b. Criteria: Document acceptance/rejection of welded joints and/or members.
 - c. Frequency: (C) Continuous inspection.
 - d. Standard: AISC 360, Chapter N.

Martin Martin Inc.
Gensler Project 003.8017.012
Martin Martin Project 26.0228.S.01

May 07, 2026
Issue for Pricing & Permit

**GJT Level 2 Amenities &
Elevator Modernization**
Grand Junction, CO

END OF SECTION 051200

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes metal fabrications.

1.2 ACTION SUBMITTALS

- A. Shop Drawings: Submit shop drawings including plans, elevations, sections, details of installation, and attachments to other Work. For installed products indicated to comply with performance requirements, include structural analysis data, for information only, and shop drawings signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel." Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- B. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 Structural Performance

- A. Countertop Framing: Provide countertop framing capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections, or of exhibiting excessive deflections in any of the components making up the countertops:
 - 1. All deadloads.
 - 2. 500 pound live load placed on the countertop.
 - 3. Deflection at Midspan: $L/1000$ times span or 1/8-inch whichever is less.
- B. Tube Framing for Partial Height Walls: Provide tube framing for partial height walls capable of withstanding a deflection not to exceed $2L/1440$ of the wall height when subjected to a positive and negative pressure of 5 psf.

- C.
- D.
- E. All-Glass Entrances and Storefront Framing: Fabricate and install all-glass entrances and storefront framing so that when installed, it is capable of supporting all deadloads and withstanding the live loads imposed on it from the operation of the all-glass entrance doors.

2.2 MATERIALS

- A. Metal Surfaces: For metal fabrications 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. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500, or hot-formed steel tubing complying with ASTM A 501.
- D. Slotted Channel Framing: Cold-formed metal channels with continuous slot and with flanged edges returned toward web complying with MFMA-3 and fabricated from steel complying with ASTM A 1011/A 1011M. Width, depth, and metal thickness as required to suit performance requirements.
- E. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- F. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664 and compatible with finish paint systems indicated.
- G. Fasteners: Zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, of type, grade, and class required by application indicated.

2.3 FABRICATION

- A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation. Welded connections may be used where bolted connections are shown.
- B. Shear and punch metals cleanly and accurately. Remove burrs.

- C. Weld corners and seams continuously along entire line of contact. Use full penetration welds. Use materials and methods that minimize distortion and develop strength of base metals. Obtain fusion without undercut or overlap. Remove welding flux immediately. Finish exposed welds smooth and blended.
- D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous. Make up threaded connections tight so that threads are entirely concealed.
- E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices and fasteners to secure metal fabrications rigidly in place and to support indicated loads.
- F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

2.4 MISCELLANEOUS FRAMING AND SUPPORTS

- A. Miscellaneous Framing and Supports: Provide steel framing and supports indicated and as necessary to complete the Work and which are not a part of the structural framework, including but not limited to framing and supports for sliding doors, countertop, projection screens, ceiling-hung audio/visual equipment, tube framing for partial height walls, and mechanical and electrical equipment.
- B. Fabricate units from structural steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - 1. All-Glass Entrances and Storefront Framing: Fabricate and install all-glass entrances and storefront framing by providing continuous steel shapes with attached bearing plates, anchors, and braces as required to sustain imposed loads.
 - 2. Countertop Framing: Fabricate framing, using steel shapes and plates, and cold finished mild steel bars at exposed conditions, for support framing and plywood, to the thicknesses, sizes and shapes shown, and as required to produce work of adequate strength and durability, without objectionable deflections. Use proven details of fabrication, as required, to achieve proper assembly and alignment of the various components of the Work.

2.5 FINISHING

- A. Finish metal fabrications after assembly. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Shop prime ferrous-metal items.

- B. Prepare uncoated ferrous-metal surfaces for shop priming by removing oil, grease, and similar contaminants in accordance with SSPC -SP 1 "Solvent Cleaning," followed with SSPC-SP 3, "Power Tool Cleaning."
- C. Apply a minimum of one coat of shop primer to uncoated surfaces of metal fabrications, except those to be field welded, and those to be embedded in sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide anchorage devices and fasteners for securing metal fabrications to in-place construction. Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, with edges and surfaces level, plumb, and true. Drill holes for bolts to the exact diameter of the bolt. Provide screws threaded full length to the screw head.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
- C. For field welding, use materials and methods that minimize distortion and develop strength of base metals. Obtain fusion without undercut or overlap. Remove welding flux immediately. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Touchup surfaces and finishes after erection. For materials exposed to view in the finished Project, clean field welds, bolted connections, and abraded areas and touchup paint with the same material as used for shop painting.

END OF SECTION

SECTION 057000 - DECORATIVE METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Visual display board frames.
2. Wall panels.
3. Decorative metal
4. |Combination hall push-button stations.
5. Metal reveals.
6. Blackened steel.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for non-decorative metal fabrications.

1.2 COORDINATION

- A. Coordinate installation of anchorages for decorative metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, including finishing materials.

- B. Shop Drawings: Show fabrication and installation details for decorative metal.

1. Include plans, elevations, component details, and attachments to other work.
2. Indicate materials and profiles of each decorative metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.

- C. Samples for Verification: For each type of exposed finish required.

1. Sections of linear shapes.
2. Samples of welded joints showing quality of workmanship and color matching of materials.
3. Samples of blackened steel on 1/4" plate steel
 - a. Sample A: (1) coat of Sculpt Nouveau Black Magic with Manufacturer's recommended number of Sculpt Nouveau Ever Clear Coats.

- b. Sample B: (2) coats of Sculpt Nouveau Black Magic with Manufacturer's recommended number of Sculpt Nouveau Ever Clear Coats.
- 4. Refer to "Mockups" article below.

1.4 INFORMATIONAL SUBMITTALS

- A. Embodied Carbon Submittals: Refer to Section 018133 "Sustainable Design Requirements - Embodied Carbon."
 - 1. Completed Environmental Product Declaration Reporting Form for each principal product type in this Section.
 - 2. For products with completed Environmental Product Declaration Reporting Forms claiming availability of an applicable EPD, provide the Product-Specific or Industry-Wide Type III Environmental Product Declaration (EPD) in compliance with ISO 14025.
 - 3. The Contractor is advised that the submission of the embodied carbon EPD materials to the USGBC is not required.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing decorative metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Installer Qualifications: Fabricator of products.
- C. Powder-Coating Applicator Qualifications: A firm experienced in successfully applying powder coatings of type indicated and employing competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockups for the following types of decorative metal:
 - a. Welded 90-degree mitered corner of MT02 tube steel with each piece of tube steel 6" long. Demonstrate final weld size, grinding level, and metal finish.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store decorative metal in a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.
- B. Deliver and store cast-metal products in wooden crates surrounded by sufficient packing material to ensure that products will not be cracked or otherwise damaged.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal by field measurements before fabrication and indicate measurements on shop drawings.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. Provide materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

2.2 STEEL AND IRON

- A. Tubing: ASTM A 500 (cold-formed).
- B. Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- E. Steel Sheet, Cold Rolled: ASTM A 1008/A 1008M, either commercial steel or structural steel, exposed.

2.3 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
 - 1. Uncoated-Steel Items: Plated steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed, Type 304 stainless-steel fasteners where exposed.
 - 2. Class Fe/Zn 25 for electrodeposited zinc coating.

3. Dissimilar Metals: Type 304 stainless-steel fasteners.
 - B. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.
 - C. Provide concealed fasteners for interconnecting components and for attaching decorative metal items to other work unless otherwise indicated.
 1. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.
 - D. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - E. Post-Installed Anchors: Torque-controlled expansion type or chemical type.
 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 unless otherwise indicated.
 2. Material for Locations Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).
- 2.4 MISCELLANEOUS MATERIALS
- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 - B. Brazing Rods: For copper alloys, provide type and alloy as recommended by producer of metal to be brazed and as required for color match, strength, and compatibility in fabricated items.
 - C. Cleaner: Provide a liquid emulsifiable alkaline soak cleaner suitable for metal surfaces. Basis-of-Design Product: E-Kleen 111; Epi, 17000 West Lincoln Avenue, New Berlin, WI 53151, voice (262) 786-9330.
 - D. Shop Primers: Provide primers that comply with Section 099123 "Interior Painting."
 - E. Intermediate Coats and Topcoats for Steel: Provide products that comply with Section 099123 "Interior Painting."
 - F. Blackened Steel: Provide Sculpt Nouveau Black Magic with Sculpt Nouveau Ever Clear Coats

2.5 FABRICATION, GENERAL

- A. Assemble items in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- B. Make up wire-rope assemblies in the shop to field-measured dimensions with fittings machine swaged. Minimize amount of turnbuckle take-up used for dimensional adjustment so maximum amount is available for tensioning wire ropes. Tag wire-rope assemblies and fittings to identify installation locations and orientations for coordinated installation.
- C. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.
- E. Form simple and compound curves in bars, pipe, tubing, and extruded shapes by bending members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces.
- F. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- G. Mill joints to a tight, hairline fit. Cope or miter corner joints. Fabricate connections that will be exposed to weather in a manner to exclude water.
- H. Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Cut, reinforce, drill, and tap as needed to receive finish hardware, screws, and similar items unless otherwise indicated.
- I. Comply with AWS for recommended practices in shop welding. Weld behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and joints of flux, and dress exposed and contact surfaces.
 - 1. Where welding cannot be concealed behind finished surfaces, finish joints to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 Welds: no evidence of a welded joint.

2.6 VISUAL DISPLAY BOARD FRAMES

- A. Fabricate visual display board frames from steel shapes, sheet or plate of thickness, size, and pattern indicated. Roll, press, and grind metal to flatten and to remove burrs and deformations. Miter frame members at corners and connect with concealed splice plates welded or brazed to back of frames.

2.7 WALL PANELS

- A. Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 4. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal wall panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.8 DECORATIVE METAL TRIM

- A. Fabricate from steel shapes, sheet or plate of thickness, size, and pattern indicated. Roll, press, and grind metal to flatten and to remove burrs and deformations. Miter corners and connect with concealed splice plates.

2.9 COMBINATION HALL PUSH-BUTTON STATIONS

- A. Fabricate units of stainless steel to comply with details indicated. Coordinate with requirements in Section 142123.16 "Machine Room-Less Electric Traction Passenger " to provide integrated, closely fitted assemblies.

1. Fabricate faceplates from 1/8-inch (3.2-mm) thick sheet with square edges. .

The 2006 International Building Code requires "pictorial sign of a standard design" with text reading "IN FIRE EMERGENCY, DO NOT USE ELEVATOR; USE EXIT STAIRS" except for elevators that are part of an accessible means of egress. Appendix O in ASME A17.1 contains an example design.

2. Provide units with emergency pictorial signs and text, complying with requirements of authorities having jurisdiction, indicating that in fire emergency, elevators should not be used and that stairways should be used instead. Engrave pictorial sign and text into front surface of faceplates to a depth of 1/16 inch (1.6 mm) with engraving painted red. Make signs 5 inches (125 mm) wide by 8 inches (200 mm) high.
3. Provide cutouts in faceplates of units for push buttons of elevator hall push-button station and elevator key switches. Coordinate locations and sizes of cutouts so additional faceplate is not required and so faces of push buttons are flush with fronts of faceplates and key switches project beyond faceplate only by depth of bezel.

2.10 FINISHES, GENERAL

- A. Decorative metal finishes are designated with Item Code MT## in the Finish Schedule and on the Drawings.
- B. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.11 STEEL AND IRON FINISHES

- A. Preparing Nongalvanized Items for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
- B. Primer Application: Apply shop primer to prepared surfaces of items unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
 1. Shop prime uncoated ferrous-metal surfaces with primers specified in Section 099123 "Interior Painting" unless indicated.
- C. Shop-Painted Finish: Comply with Section 099123 "Interior Painting."
 1. Color: As indicated in Finish Schedule by manufacturer's designations.

- D. Powder-Coat Finish: Prepare, treat, and coat nongalvanized ferrous metal to comply with resin manufacturer's written instructions and as follows:
1. Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 2. Treat prepared metal with iron-phosphate pretreatment, rinse, and seal surfaces.
 3. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils (0.04 mm).
 4. Color: As indicated in Finish Schedule by manufacturer's designations.
- E. Blackened Steel Finish: Prepare, treat, and clean nongalvanized ferrous metal to receive coatings as specified in finish schedule.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.
- B. Perform cutting, drilling, and fitting required to install decorative metal. Set products accurately in location, alignment, and elevation, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.
- C. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.
- D. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- E. Install concealed gaskets, joint fillers, insulation, and flashings as work progresses.
- F. Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.
1. Retain protective coverings intact; remove coverings simultaneously from similarly finished items to preclude nonuniform oxidation and discoloration.
- G. Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal arc welding and requirements for welding and for finishing welded connections in "Fabrication, General" Article. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

3.2 VISUAL DISPLAY BOARD FRAMES

- A. Mount decorative display boards at heights and in positions indicated with concealed fasteners.
 - 1. Secure to framing and blocking with specified fasteners.
 - 2. On marble, brick, and other solid surfaces, secure with wood screws in lead plugs.

3.3 INSTALLING WALL PANELS

- A. Install paneling level, plumb, true, and straight with no distortions. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm). Install with no more than 1/16 inch in 96-inch (1.6 mm in 2400-mm) vertical cup or bow and 1/8 inch in 96-inch (3 mm in 2400-mm) horizontal variation from a true plane.
 - 1. For flush paneling with revealed joints, install with variations in reveal width, alignment of top and bottom edges, and flushness between adjacent panels not exceeding [1/32 inch (0.8 mm)] [1/16 inch (1.5 mm)].
- B. Anchor paneling to supporting substrate with concealed panel-hanger clips. Do not use face fastening unless otherwise indicated.

3.4 INSTALLING DECORATIVE METAL TRIM

- A. Assemble trim and complete fabrication at Project site to the extent that it was not completed in the shop.
- B. Install trim level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- C. Scribe and cut trim to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- D. Anchor trim to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners. Use fine finishing screws for exposed fastening, countersunk and filled flush with trim using filler matching finish of items being installed.
- E. Install with minimum number of joints possible, using full-length pieces (from maximum length of material available) to greatest extent possible. Do not use pieces less than 96 inches (2400 mm) long except where shorter single-length pieces are necessary.

3.5 INSTALLING COMBINATION HALL PUSH-BUTTON STATIONS

- A. Coordinate installation of combination hall push-button stations with installation of related elevator signal equipment components specified in Section 142100 "Electric Traction Elevators." Secure units in place with faceplate overlapping surrounding wall finish and drawn into contact with surrounding wall finish at entire perimeter of faceplate.

3.6 CLEANING AND PROTECTION

- A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- C. Protect finishes of decorative metal from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering at time of Substantial Completion.
- D. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide miscellaneous lumber for support or attachment of other construction, including blocking, nailers, and similar members.
- B. Provide plywood panels for countertop underlayment and backing panels.

PART 2 - PRODUCTS

2.1 LUMBER AND PLYWOOD

- A. Lumber: Comply with DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review. Provide dressed lumber, S4S, unless otherwise indicated. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less.
- B. Wood Panels: Comply with DOC PS 1 for plywood panels.
 - 1. Concealed Plywood for Countertop Underlayment: DOC PS 1 "Construction and Industrial Plywood," Exterior grade, manufactured with no added urea-formaldehyde, in thickness as indicated but not less than 3/4 inch.
 - 2. Telephone, Data, Security, Audio/Visual, and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D plugged, sanded both sides, fire-retardant treated, manufactured with no added urea-formaldehyde, in thickness indicated or, if not indicated, not less than 1/2 inch thick.
- C. Fire-Retardant-Treated Materials: Provide chemical fire retardant process tested and labeled by UL with flame spread and smoke developed ratings of 25 or less. Comply with performance requirements in AWP A U1, Use Category UCFA as a minimum for pressure treatment. Size wood before treatment so that minimum cutting will be required after treatment. Kiln dry lumber to a maximum 19 percent moisture content, kiln dry plywood to a maximum 15 percent moisture content, after treatment. Treat indicated items and wood members required to be treated by Building Code having jurisdiction at the site and wood members specified as fire-retardant-treated. Identify fire-retardant-treated wood with appropriate classification marking of UL.
- D. Fasteners: Provide fasteners of size and type required to support miscellaneous wood carpentry and applied loads.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Securely attach carpentry work as indicated and according to applicable codes and recognized standards.
- C. Use fasteners of appropriate type and length. Predrill members when necessary to avoid splitting wood.
- D. Install wood blocking and nailers where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.
- E. Install panel products to comply with applicable recommendations contained in APA Form No. E30, "APA Engineered Wood/Construction Guide," and local utility requirements, if any, for plywood backing panels utilized as indicated. Bolt countertop underlayment to miscellaneous steel framing. Secure plywood backing panels to wall using proper fastening devices for substrates encountered spaced 12 inches on center maximum at perimeter 1/2 inch from corners and three rows of three fasteners each in the backerboard field. Countersink fasteners flush with plywood surface. Butt adjacent panels without lapping.

END OF SECTION

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes, but is not limited to, the following items of interior architectural woodwork:

1. Plastic-laminate cabinets.
2. Interior standing and running trim.

1.2 ACTION SUBMITTALS

- A. Shop Drawings: Submit shop drawings showing locations of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components. . Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections. Show locations and sizes of cutouts and holes for plumbing, electrical, computer and telephone equipment and other items installed in architectural woodwork. Elevations shall be drawn at a scale of not less than 1/2" = 1'-0" (1:25). Details shall be drawn at a scale of not less than 3" = 1'-0" (1:5).
- B. Samples: Submit the following:
1. Lumber products with shop-applied primer, for each finish system and color, with exposed surface finished. Furnish lumber in 12 inch lengths.
 2. Plastic laminate materials, 3 inches (75 mm) square.

1.3 QUALITY ASSURANCE

- A. Quality Standard: Fabricate and install all architectural woodwork in accordance with the applicable requirements of Architectural Woodwork Standards, 2nd edition, published jointly by AWI, AWMAC, and WI, unless more stringent requirements are specified or shown.
- B. Fire Performance Characteristics: Provide materials identical to those tested for the following fire performance characteristics per ASTM test methods indicated by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify treated lumber with classification marking of inspecting and testing organization in the form of separable paper label or, where required by authorities having jurisdiction, of imprint on lumber surfaces that will be concealed from view after installation.

- C. Surface Burning Characteristics for Concealed Blocking, Furring, and Door Subframing: Not exceeding a flame spread of 25, and smoke developed of 50 when tested per ASTM E 84 for 30 minutes.
- D. The fire performance finish requirements for all exposed interior wall and ceiling woodwork (including the paneling, but not limited to paneling) substrates in fully sprinklered spaces shall comply with IBC 2012, Table 803.9 or IBC 2015.803.11.

1.4 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify actual dimensions of other construction by accurate field measurements before fabrication of woodwork; and indicate measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed and indicate measurements on shop drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade specified.
- B. Lumber Standards: Comply with applicable provisions for grading and workmanship of AWS Architectural Woodwork Standards, Section 3, and the requirements shown and specified; where standards conflict the more stringent shall apply. Provide lumber surfaced 4 sides (S4S) and fabricated to profiles shown. All lumber shall be kiln dried to the moisture content indicated in AWS, Section 2.
- C. Furring, Blocking, Shims: No. 1 Common; Southern Pine.
- D. Solid Hardwood for Opaque Finish: Plain sawn Yellow Poplar, free from checks, splits, sound knots.
- E. Wood Panel Products:

1. Medium-Density Fiberboard (MDF): ANSI A208.2, having a minimum 48 pcf density except that minimum for screw holding capacity on face shall be 300 pounds; an ASTM E 84 minimum Class C flame spread rating, minimum 3/4 inches (19 mm) thick, edged and faced as specified, fabricated with binder containing no added urea formaldehyde. Provide moisture-resistant MDF when subject to wetting.
 2. Hardboard: ANSI A135.4.
- F. Thermoset Decorative Overlay (Melamine): Medium-density fiberboard with surface of thermally fused, melamine-impregnated decorative paper complying with the recommendations of the Composite Panel Association's Technical Bulletin "Laminating Composite Panels."
- G. High-Pressure Decorative Laminate: Provide product indicated in Finish Schedule.
1. Backing Sheets: Non-decorative, high pressure laminate, NEMA LD3, Grade, types and thickness to match face sheets and equalize pull.
- H. Adhesives: Use only low emitting VOC adhesives that leave no glue lines on finished surfaces of architectural woodwork. Do not use adhesives that contain urea formaldehyde. Use installation adhesives that do not exceed the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Wood Glues: 30 g/L.
 2. Contact Adhesives: 80 g/L.
- I. Fire-Retardant-Treated Materials: Where indicated, use materials impregnated with fire-retardant chemical formulations indicated by a pressure process or other means acceptable to authorities having jurisdiction to produce products with fire-test-response characteristics specified.
1. Do not use treated material that does not comply with requirements of referenced woodworking standard. Do not use twisted, warped, bowed, discolored, or otherwise damaged or defective lumber or panel products.
 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.
 3. Treat only door subframing, blocking and furring items.

2.2 CABINET HARDWARE

- A. Hardware Standard: Comply with BHMA A156.9 for items indicated by referencing BHMA numbers or items referenced to this standard.
- B. Frameless Concealed Hinges for Cabinet Doors (European Type): BHMA A156.9, B01602. Bright nickel finish (US15). Provide hinge quantity as recommended by hinge manufacturer based on cabinet door width, weight, thickness, door material, and hinge cup selection. Automatic soft closing shall engage only in the last 10 degrees of swing.

- C. Wire Pulls: As specified in Drawings.
- D. Angled Pulls: As specified in Drawings.
- E. Cabinet Shelf Rests: Provide one of the following:
 - 1. Hafele America, Co.; Hafele 282.01.701 x 282.50.704.
 - 2. Knappe and Vogt; 331 Series Flat Top Shelf Support Pin with 325 Series Insert Grommet.
- F. Drawer Slides:
 - 1. Pencil Drawer Slides: Accuride, Inc.; Model No. 2132 or 2006.
 - 2. Drawers less than 4 inches (102 mm) deep: Accuride, Inc.; Model No. 7432, 100 lb. (45 kg) capacity medium duty load rating, bright electro zinc plate finish.
 - 3. Drawers greater than 4 inches (102 mm) but less than 8 inches (203 mm) deep: Accuride, Inc.; Model No. 7432, 100 lb. (45 kg) capacity medium duty load rating, bright electro zinc plate finish.
 - 4. Drawers greater than 8 inches (203 mm) deep: Accuride, Inc.; Model No. 4032, 150 lb. (68 kg) capacity heavy duty load rating, bright electro zinc plate finish.
 - 5. Refuse Cabinets: Accuride, Inc.; Model No. 3600-201, 175 lb. (79 kg) capacity heavy duty load rating, bright electro zinc plate finish.
 - 6. Flipper Door Slides: Accuride, Inc.; Model No. 1432, bright electro zinc plate finish.
- G. Silencers: Provide rubber silencers on jamb and/or head and sill strike areas of all cabinet doors and drawers, 2 for paired doors, and 3 for single doors. Silencers shall be approximately 1/4 inch (6.3 mm) diameter, color compatible with adjacent finish.
- H. Grommets for Cable Passage through Countertops: 2-1/2 inch (63.5 mm) metal grommets and matching caps with slot for wire passage.
- I. Exposed Hardware Finishes: Unless otherwise specified above, or on the Drawings, all exposed portions of the woodwork hardware shall comply with BHMA A156.18 for BHMA finish number indicated.
 - 1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
 - 2. Satin Stainless Steel: BHMA 630.

2.3 FABRICATION

- A. Fabrication: Complete fabrication, including assembly, finishing, and hardware application, before shipment to Project site to the maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting. The width of scribe and filler panels shall not exceed 1/2 inch (12.7 mm), or 1/2 inch (12.7 mm) clear dimension from adjacent wall to outside face of cabinet door in a 90 degree position, whichever is greater.

- B. Interior Woodwork Grade: Provide Custom Grade at plastic laminate-finished woodwork and woodwork primed for field painting.
- C. Wood Cabinets for Plastic Laminate Finish:
 - 1. AWS Type of Cabinet Construction: Comply with AWS Section 10, Style 1, Type A Construction; flush overlay.
 - 2. Laminate Cladding for Exposed Surfaces: Grade HGS for horizontal surfaces other than tops and edges; Grade HGP for postformed surfaces; Grade VGS for vertical surfaces.
 - 3. Materials for Semiexposed Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.
 - 4. Drawer Sides and Backs: Solid-hardwood lumber.
 - 5. Drawer Bottoms: Hardwood plywood.
- D. Plastic Laminate Countertops: Comply with AWS Section 11, and as follows:
 - 1. High-Pressure Decorative Laminate Grade: HGS.
 - 2. Edge Treatment: Same as laminate cladding on horizontal surfaces unless otherwise indicated.
 - 3. Core Material at Sinks: Exterior-grade plywood.
- E. Interior Standing and Running Trim: Comply with AWS Sections 3 and 6, and as follows:
 - 1. Fabricate from solid hardwood with scarfed joints, profiles as indicated, finishes as indicated. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
 - 2. Wood Species: Poplar for opaque finishes.

2.4 SHOP FINISHING

- A. Production finish architectural woodwork at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.
- B. Priming of interior architectural woodwork with field applied opaque finish required to be performed at fabrication shop are specified in this Section. Refer to Section 099123 "Interior Painting" for finishing opaque finished architectural woodwork.
- C. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
 - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative overlay.

D. Exposed Surfaces:

1. Primed for Field Painting: Shop-applied primer compatible with finish coats specified in Section 099123 "Interior Painting."
2. Plastic Laminate Finish: Gluing of plastic laminate surfacing materials shall be by the hot plate method, glued surfaces shall be in close contact throughout. Glue stains shall not be permitted.

E. Unexposed Wood Finish: Shop-applied alkyd type primer-sealer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install woodwork to comply with AWS Section 10 for the same grade specified in this Section for type of woodwork involved.
- B. Install woodwork level, plumb, true, with no distortions, and with no variations in flushness of adjoining surfaces. Shim as required with concealed shims.
- C. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.
- D. Anchor woodwork to blocking built in or directly attached to substrates. Secure to blocking with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- E. Install standing and running trim with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 96 inches (2438 mm) long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base, if finished.
- F. Install cabinets without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated. Install cabinets without sag, bow, or other variation from a straight line. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) on center with No. 10 wafer-head screws sized for 1 inch (25 mm) penetration into wood blocking, or hanging strips or with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

- G. Anchor countertops securely by screwing through corner blocks of base cabinets or other supports into underside of countertop. Caulk space between backsplash and wall with silicone sanitary sealant specified in Section 079200 "Joint Sealants." Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) on center and to walls with adhesive.
- H. Complete the finishing work specified in this Section to extent not completed at shop or before installation of woodwork.

3.2 CLEANING AND PROTECTION

- A. Repair damaged and defective woodwork to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.
- C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer, that ensures that woodwork will be without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes interior joint sealants.

1.2 SUBMITTALS

- A. Product Data: Submit product data for each joint sealant product indicated.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers. Store and handle materials in compliance with manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Architectural Sealants: Not more than 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: Not more than 250 g/L.
 - 3. Sealant Primers for Porous Substrates: Not more than 775 g/L.
- B. Colors: For fully concealed joints, provide the manufacturer's standard color of sealant which has the best overall performance characteristics for the application shown. For exposed joints, the Architect will select colors from the manufacturer's standard colors.

2.2 JOINT SEALANTS

- A. Sealants for Contact with Food: Comply with 21 CFR 177.2600, NSF Standard 51, and ASTM C 920 for Type S, Grade NS, Class 25, Use NT.
 - 1. Dow Corning; 786 Mildew Resistant Silicone Sealant.
- B. Mildew-Resistant Silicone Sealant (use for joints at plumbing fixtures, toilet room countertops and vanities): Complying with ASTM C 920, Type S (single component), Grade NS (non-sag), class 25, Use NT (non-traffic), Substrate uses G, A, and O; and containing a fungicide for mildew resistance; white color.

1. Products: Provide one of the following:
 - a. Dow Corning; 786 Mildew Resistant Silicone Sealant.
 - b. Momentive; Sanitary SCS 1700.
 - c. Pecora Corporation; 898 Silicone Sanitary Sealant.
 - d. Tremco, an RPM Co.; Tremsil 200 Sanitary.
- C. Latex Sealant: Complying with ASTM C 834, Type OP (opaque sealants):
 1. Products: Provide one of the following:
 - a. Pecora Corporation; AC-20 + Silicone.
 - b. DAP Products Inc.; Alex Plus Acrylic Latex Caulk Plus Silicone.
 - c. Tremco, an RPM Co.; Tremflex 834.

2.3 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: One of the following preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding backings of flexible plastic foam complying with ASTM C 1330, and of type indicated below. Select shape and density of cylindrical sealant backings in consultation with the manufacturer for proper performance in specific condition of use in each case.
 1. Type C: Closed-cell polyethylene foam material with a surface skin, which is nonabsorbent to liquid water and gas, non-outgassing in unruptured state; one of the following:
 - a. HBR Closed Cell Backer Rod; Nomaco, Inc.
 - b. MasterSeal 920; MBCC Group Master Builders Solutions (formally BASF).
 - c. Mile High Foam, Backer Rod Mfg., Inc.

2.4 MISCELLANEOUS MATERIALS

- A. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.
- B. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and which will not stain nor mar the finish of surfaces adjacent to joints to which it is applied.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. **Surface Cleaning of Joints:** Clean out joints immediately before installing joint sealants to comply with the recommendations of joint sealant manufacturer and the following requirements:
1. Remove foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), existing joint sealants, oil, grease, water, and surface dirt.
 2. Clean concrete, masonry, unglazed surfaces of tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
 3. Remove laitance and form-release agents from concrete.
 4. Clean metal, glass, porcelain enamel, glazed surfaces of tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. **Masking Tape:** Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.
- C. **Installation of Sealant Backings:** Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
- D. **Installation of Sealants:** Install sealants so they directly contact and fully wet joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths 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, concave shaped beads, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint.
- F. **Cleaning:** Clean excess sealants or sealant smears adjacent to joints as installation progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.2 JOINT SEALANT SCHEDULE

- A. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
1. Control and Expansion Joints on Exposed Interior Surfaces of Exterior Walls: Latex sealant.
 2. Perimeter Joints of Exterior Openings Where Indicated: Latex sealant.
 3. Vertical Control and Expansion Joints in Tile Surfaces: Latex sealant.
 4. Horizontal Control and Expansion Joints in Tile Flooring Surfaces: Two-Part Polyurethane Sealant for Paving Applications.
 5. Vertical Control Joints on Exposed Surfaces of Interior Unit Masonry and Concrete Walls and Partitions: Latex sealant.
 6. Perimeter Joints between Interior Wall Surfaces and Frames of Interior Doors, Windows, and Elevator Entrances: Latex sealant.
 7. Perimeter Joints between Scalloped, Bent, or Warped Interior Wallboard Surfaces and Straight Trim: Latex Sealant.
 8. Joints between Plumbing Fixtures and Adjoining Walls, Floors, and Counters: Mildew-resistant silicone sealant.

END OF SECTION

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes

1. Hollow metal doors and frames.
2. The integration of a security system into the hollow metal door and frame work is required. The Contractor shall be responsible for the total and complete coordination of the security system components into the Work.

1.2 REFERENCES

- A. Hollow Metal Door and Frame Standard: Comply with the applicable provisions and recommendations of the following publications by Hollow Metal Manufacturers Association (HMMA) Div. of National Association of Architectural Metal Manufacturers (NAAMM), unless more stringent requirements are indicated in the Contract Documents:

1. HMMA "Hollow Metal Manual."
2. HMMA 861 "Guide Specifications for Commercial Hollow Metal Doors and Frames."

1.3 ACTION SUBMITTALS

- A. Product Data: Submit product data for each product indicated. Include material descriptions, core descriptions, label compliance, sound and fire-resistance ratings, and finishes for each type of door and frame specified.
- B. Shop Drawings: Submit door and frame schedule using same reference designations indicated on Drawings. Include opening size(s), handing of doors, frame throat dimensions, details of each frame type, elevations of door design types, details of construction, location and installation requirements of door hardware and reinforcements, hardware group numbers, details of joints and connections, fire label requirements including fire rating time duration, maximum temperature rise requirements, and smoke label requirements.
1. Indicate routing of electrical conduit and dimensions and locations of cutouts in doors and frames to accept electric hardware devices.
 2. Show direction of satin stainless steel finish.

1.4 INFORMATIONAL SUBMITTALS

- A. TVOC Emissions: Submit laboratory test reports or third-party certificates showing compliance with the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers" version 1.2-2017.
- B. Material Ingredient Disclosure: Submit one of the following reports:
 - 1. Health Product Declaration.
 - 2. UL Product Lens.
 - 3. Living Building Challenge Declare Label or Living Product Challenge Label.
 - 4. EPEA Material Health Statement.
 - 5. Cradle-to-Cradle v4 Material Health Certificate or multi-attribute certificate.
- C. Certificate of Compliance for Fire Rated Doors: Provide copies of Certificate of Compliance for all fire rated door assemblies, all smoke and draft control door assemblies, and all temperature rise rated door assemblies.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing hollow metal doors and frames similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. TVOC Emissions: For door and frame products with organic coatings, obtain products with publicly available reports or certificates verifying compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers" version 1.2-2017, following the private office scenario.
- C. Material Ingredient Disclosure: Obtain the following products with publicly available reports disclosing material ingredients to residuals no greater than 1000ppm:
 - 1. Typical Interior Hollow Metal Doors.
 - 2. Welded Frames.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect doors and frames during transit and storage from damage using pallets, crates, or wrappings provided by the door and frame manufacturer.

- B. Inspect doors and frames, on delivery, for damage. Tool marks, rust, blemishes, and other damage on exposed surfaces will not be acceptable. Remove and replace damaged items as directed by Architect. Store doors and frames at building site in a dry location, off the ground, and in such a manner as to prevent deterioration.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide doors and frames by one of the following:
 - 1. Hollow Metal Doors and Frames:
 - a. Ceco Door Products; an Assa Abloy Group Company.
 - b. Curries Company; an Assa Abloy Group Company.
 - c. Steelcraft; an Allegion PLC Company.

2.2 PERFORMANCE CRITERIA

- A. Fire-Rated Door Assemblies: Provide assemblies that comply with NFPA 80 and that are labeled and listed by a testing service which is acceptable to the authority having jurisdiction for the fire ratings indicated on the drawings based on laboratory testing using positive pressure according to UL10C or NFPA 252. Fire classification labels at all doors with fire ratings greater than 20 minutes shall indicate the temperature rise developed on the unexposed surface of the door after the first 30 minutes of fire exposure.
 - 1. Provide metal labels permanently fastened on each door which is within the size limitations established by the labeling authority having jurisdiction.
 - 2. Temperature-Rise Rating: Where indicated, provide doors that have a temperature-rise rating of 450 deg F (250 deg C) maximum in 30 minutes of fire exposure.
 - 3. Positive Pressure Rated Door Assemblies: Where indicated provide positive pressure rated fire rated door assemblies. Sizes and configurations as shown on the Drawings. Installed door assemblies shall be in accordance with door manufacturer's certified assemblies.
 - a. Test Pressure: Test according to NFPA 252 or UL 10C. After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches (1000 mm) or less above the sill.
- B. Smoke-Control Door Assemblies: Where indicated provide gasketed assemblies labeled and listed by a testing service which is acceptable to the authority having jurisdiction for the smoke ratings indicated on the drawings based on laboratory testing according to UL 1784. Install smoke controlled assemblies to comply with NFPA 105.

2.3 MATERIALS

- A. Cold-Rolled Steel Sheets: ASTM A 1008/A 1008M, CS (commercial steel), Type B; free from scale, pitting, coil breaks, surface blemishes, buckles, waves, or other defects, exposed (matte) dull finish, suitable for exposed applications.
- B. Inserts, Bolts, and Fasteners: Galvanized steel.
 - 1. Expansion Bolts and Shields: FS FF-S-325, Group III, Type 1 or 2.
 - 2. Machine Screws: FS FF-S-92, carbon steel, Type III cross recessed, design I or II recess, style 2C flat head.
- C. Filler: Sound deadening and heat retarding mineral fiber insulating material.
- D. Glass and Glazing: Refer to Section 088000 "Glazing."
- E. Hardware: Refer to Section 087100 "Door Hardware."

2.4 HOLLOW METAL DOOR AND FRAME FABRICATION, GENERAL

- A. Fabricate doors and frames rigid, neat in appearance, and free of defects, warp, wave, and buckle. Accurately form metal to sizes and profiles indicated. Accurately machine, file, and fit exposed connections with hairline joints. Weld exposed joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
- B. Exposed Fasteners: Provide countersunk flat heads for exposed screws and bolts, unless otherwise indicated.
- C. Hardware Preparation: Prepare doors and frames to receive hardware, including cutouts, reinforcement, mortising, drilling, and tapping, according to final hardware schedule and templates provided by hardware supplier. Secure reinforcement by spot welding. Comply with applicable requirements of ANSI/BHMA A156.115 and A156.115W specifications for door and frame preparation for hardware. Factory-reinforce doors and frames to receive surface-applied hardware. Factory drill and tap for surface-applied hardware, except at pushplates and kickplates provide reinforcing only.
 - 1. Locate hardware as indicated on the Drawings or in Section 087100 "Door Hardware" or, if not indicated, according to HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."

2.5 DOOR FABRICATION

- A. General: Provide flush-design doors, 1-3/4 inches (44 mm) thick, of seamless hollow construction, unless otherwise indicated. Construct doors with sheets joined at their vertical edges by continuous welding the full height of the door, or joined at vertical edges by 1 inch (25.4 mm) spot welds 6 inches (150 mm) on center, or intermittently welded seams. Voids between spot and intermediate welds shall be epoxy edge filled. Grind and finish all welds and edge fills flush to result in invisible seams on the door faces or vertical door edges.
1. Visible joints or seams around glazed or louvered panel inserts are permitted.
 2. For single-acting swing doors, bevel both vertical edges 1/8 inch in 2 inches (3 mm in 50 mm).
 3. For double-acting swing doors, round vertical edges with 2-1/8-inch (54-mm) radius.
- B. Interior Door Core Construction: Doors shall be stiffened by continuous vertically formed steel sections which, upon assembly, shall span the full thickness of the interior space between door faces. These stiffeners shall be 20 gauge (0.032-inch-) (0.8-mm-) minimum thickness, spaced so that the vertical interior webs shall be not more than 6 inches (150 mm) apart and spot welded to face sheets a maximum of 5 inches (127 mm) o.c. Place filler between stiffeners for full height of door.
- C. Astragals: As required by NFPA 80 to provide fire ratings indicated.
- D. Top and Bottom Channels: Spot weld metal channel not less than thickness of face sheet to face sheets not more than 6 inches (150 mm) o.c.
1. Reinforce tops and bottoms of doors with inverted horizontal channels of same material as face sheet so flanges of channels are even with bottom and top edges of face sheets.
- E. Hardware Reinforcement: Fabricate reinforcing from the same material as door to comply with the following. Offset reinforcement so that faces of mortised hardware items are flush with door surfaces.
1. Hinges and Pivots: 7 gauge (0.167 inch) (4.2 mm) thick by 1-1/2 inches (38 mm) wide by 9 inches (229 mm).
 2. Lock Front, Strike, and Flushbolt Reinforcements: 12 gauge (0.093 inch) (2.3 mm) thick by size as required by hardware manufacturer.
 3. Lock Reinforcement Units: 14 gauge (0.067 inch) (1.7 mm) thick by size as required by hardware manufacturer.
 4. Closer Reinforcements: 12 gauge (0.093 inch) (2.3 mm) thick one-piece channel by size as required by hardware manufacturer.
 5. Other Hardware Reinforcements: As required for adequate strength and anchorage.
 6. In lieu of reinforcement specified, hardware manufacturer's recommended reinforcing units may be used.

7. Exit Device Reinforcements: 12 gauge (0.093 inch) (2.3 mm) thick by 10 inches (245 mm) high by 4 inches (101 mm) wide centered on exit device case body, unless otherwise recommended by exit device manufacturer.
- F. Electrical Requirements: Make provisions for installation of electrical items specified elsewhere; arrange so wiring can be readily removed and replaced.
1. Provide all cutouts and reinforcements required for hollow metal doors to accept security system components.
 2. Doors with Electric Hinges and Pivots: Provide with metal conduit or raceway to permit wiring from electric hinge or pivot to other electric door hardware.
 - a. Hinge Location: Center for doors less than 90 inches (2286 mm) tall or second hinge from door bottom for doors greater than 90 inches (2286 mm); top or bottom electric hinge locations shall not be permitted.
- G. Interior Hollow Metal Doors:
1. Typical Interior Doors: Flush design with 16 gauge (0.053-inch-) (1.3-mm-) thick cold-rolled stretcher-leveled steel face sheets and other metal components from hot- or cold-rolled steel sheets.
 2. Extra Heavy Use Doors: Flush design with 14 gauge (0.067-inch-) (1.7-mm-) thick cold-rolled, stretcher-leveled steel face sheets and other metal components from hot- or cold-rolled steel sheets. Provide only where indicated.
- 2.6 FULL GLAZED STILE AND RAIL DOOR FABRICATION
- A. Form doors with stiles and rails of continuous steel channels, fabricated from not lighter than 16 gauge (0.053 inches) (1.3 mm) thick cold rolled steel, welded together to form a rigid tubular frame. Door corners shall be mitered and butted. Mitered joints shall be internally reinforced, welded, and ground smooth such that no miter joints appear on the door faces. Intermediate rails shall be butted and internally welded to door stiles. Continuously weld all joints for the full height of the door, with no visible seams on their faces, horizontal, or vertical edges, and all welds ground and finished flush.
- 2.7 DUTCH DOOR FABRICATION
- A. Fabricate as specified for flush doors. Provide shelf with boxed edges and closed ends; fabricate from 16 gauge (0.053 inches) (1.3 mm) thick cold rolled steel sheet. Support shelf on door manufacturer's standard steel brackets, unless otherwise indicated.
- 2.8 PANEL FABRICATION
- A. Provide panels of same materials, construction, and finish as specified for doors.

2.9 WELDED FRAME FABRICATION

- A. Fabricate hollow metal frames, formed to profiles indicated, with full 5/8 inch (16 mm) stops, and of the following minimum thicknesses.
 - 1. For interior use, form frames from cold- rolled steel sheet of the following thicknesses:
 - a. Openings up to and Including 48 Inches (1200 mm) Wide: 16 gauge (0.053 inch) (1.3 mm).
 - b. Openings More Than 48 Inches (1200 mm) Wide: 14 gauge (0.067 inch) (1.7 mm).
 - 2. Frame heads at all masonry openings shall be formed to extend to the lowest CMU horizontal mortar joint.
- B. Provide frames either saw mitered and full (continuously) profile welded, or machine mitered and full profile welded, on back side at frame corners and stops with edges straight and true. Grind welds smooth and flush on exposed surfaces.
- C. Hardware Reinforcement: Fabricate reinforcements from same material as frame to comply with the following. Offset reinforcement so that faces of mortised hardware items are flush with surface of the frame.
 - 1. Hinges and Pivots: 7 gauge (0.167 inch) (4.2 mm) thick by 1-1/4 inches (32 mm) wide by 10 inches (254 mm).
 - 2. Strike, Surface Mounted Hold Open Arms, and Flushbolt Reinforcements: 12 gauge (0.093 inch) (2.3 mm) thick by size as required by hardware manufacturer.
 - 3. Closer Reinforcements: 12 gauge (0.093 inch) (2.3 mm) thick one piece channel by size as required by hardware manufacturer.
 - 4. Other Hardware Reinforcements: As required for adequate strength and anchorage.
- D. Electrical Requirements: Make provisions for installation of electrical items specified elsewhere; arrange so wiring can be readily removed and replaced.
 - 1. Provide all cutouts and reinforcements required for steel frames to accept security system components.
 - 2. Frames with Electric Hinges and Pivots: Provide welded on UL listed back boxes with metal conduit or raceway to permit wiring from electric hinge or pivot to other electric door hardware.
 - a. Hinge Location: Center for doors less than 90 inches (2286 mm) tall or second hinge from door bottom for doors greater than 90 inches (2286 mm); top or bottom electric hinge locations shall not be permitted.

- E. Mullions and Transom Bars for Sidelights, Transoms, and Borrowed Light Frames: Provide closed or tubular mullions and transom bars where indicated. Fasten mullions and transom bars at crossings and to jambs by butt welding. Reinforce joints between frame members with concealed clip angles or sleeves of same metal and thickness as frame.
- F. Jamb Anchors: Locate jamb anchors above hinges and directly opposite on strike jamb as required to secure frames to adjacent construction. At metal stud partitions locate the additional jamb anchor below the top hinge.
1. Masonry Construction: Adjustable, corrugated or perforated, anchors to suit frame size; formed of same material and gauge thickness as frame; at non-rated frames use friction fit T-shaped anchors, at rated frames use anchors consisting of spot welded strap and adjustable anchor; with leg not less than 2 inches (50 mm) wide by 10 inches (250 mm) long. Unless closer spacing is required to meet the performance requirements furnish at least the number of anchors per jamb according to the following frame heights:
 - a. Two anchors per jamb up to 60 inches (1500 mm) in height.
 - b. Three anchors per jamb from 60 to 90 inches (1500 to 2250 mm) in height.
 - c. Four anchors per jamb from 90 to 96 inches (2250 to 2400 mm) in height.
 - d. One additional anchor per jamb for each 24 inches (600 mm) or fraction thereof more than 96 inches (2400 mm) in height.
 2. Metal-Stud Partitions: Metal channel stud zee anchor sized to match stud width, welded to back of frames, formed of same material and gauge thickness as frame. Unless closer spacing is required to meet the performance requirements provide at least the number of anchors for each jamb according to the following heights:
 - a. Three anchors per jamb up to 60 inches (1500 mm) in height.
 - b. Four anchors per jamb from 60 to 90 inches (1500 to 2250 mm) in height.
 - c. Five anchors per jamb from 90 to 96 inches (2250 to 2400 mm) in height.
 - d. One additional anchor per jamb for each 24 inches (600 mm) or fraction thereof more than 96 inches (2400 mm) in height.
 3. In-Place Concrete or Masonry: Anchor frame jambs with minimum 3/8-inch-(9-mm-) diameter countersunk flat head bolts into expansion shields or inserts 6 inches (150 mm) from top and bottom of each jamb with intermediate anchors spaced a maximum of 26 inches (650 mm) o.c. unless closer spacing is required to meet the performance requirements. Soffit face of frame shall be punched and dimpled to accept countersunk bolt head. Reinforce frame with spacer to prevent bowing. Bolt head shall be set slightly below soffit face, filled and ground smooth at time of installation.
- G. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, formed of same material as frame, 12 gauge (0.093 inch) (2.3 mm) thick, and punched with two holes to receive two 0.375 inch (9.5 mm) fasteners. Where floor fill or setting beds occur support frame by adjustable floor anchors bolted to the structural substrate. Terminate bottom of frames at finish floor surface. Weld floor anchors to frames with at least 4 spot welds per anchor.

- H. Head Strut Supports: Provide 3/8-by-2-inch (9-by-50-mm) vertical steel struts extending from top of frame at each jamb to supporting construction above. Bend top of struts to provide flush contact for securing to supporting construction above by bolting, welding, or other suitable anchorage. Provide adjustable wedged or bolted anchorage to frame jamb members to permit height adjustment during installation. Adapt jamb anchors at struts to permit adjustment.
 - I. Head Reinforcement: For frames more than 48 inches (1200 mm) wide in masonry wall openings, provide continuous steel channel or angle stiffener, 12 gauge (0.093 inch) (2.3 mm) thick for full width of opening, welded to back of frame at head. Head reinforcements shall not be used as a lintel or load-bearing member for masonry.
 - J. Spreader Bars: Provide removable spreader bar across bottom of frames to serve as bracing during shipment and handling and to hold frames in proper position do not tack weld bars to frames.
 - K. Door Silencer Holes: Drill strike jamb stop to receive three silencers on single door frames and for two silencers on double door frames. Insert plastic plugs in holes to keep holes clear during installation.
 - L. Plaster, Mortar and Grout Guards and Removable Access Plates: Provide minimum 26 gauge (0.016-inch-) (0.4-mm-) thick guards or dust-cover boxes of same material as frame, welded to frame at back of hardware cutouts to close off interior of openings and prevent mortar or other materials from obstructing hardware and hardware fastener installation and hardware operation. Provide removable access plates in the heads of frames to receive overhead concealed door closers.
- 2.10 STOP AND MOLDING FABRICATION
- A. Provide continuous stops and moldings around solid, glazed, and louvered panels where indicated.
 - B. Form fixed stops and moldings integral with frame, on the exterior (non-secured) side of the frame.
 - C. Provide removable stops and moldings formed of 20 gauge (0.032-inch-) (0.8-mm-) thick steel sheets matching hollow metal frames. Secure with countersunk oval head machine screws spaced uniformly not more than 12 inches (300 mm) o.c. Form corners with butted or mitered hairline joints.
 - D. Coordinate rabbet width between fixed and removable stops with type of glass or panel and type of installation indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install doors and frames according to the referenced standards, the Architect reviewed shop drawings, and manufacturer's written recommendations and installation instructions.
- B. Frames: Install frames where indicated. Extend frame anchorages below fills and finishes. Coordinate the installation of built-in anchors for wall and partition construction as required with other work.
 - 1. Welded Frames:
 - a. Set masonry anchorage devices where required for securing frames to in-place concrete or masonry construction.
 - 1) Set anchorage devices opposite each anchor location as specified and anchorage device manufacturer's written instructions. Leave drilled holes rough, not reamed, and free of dust and debris.
 - b. Placing Frames: Set frames accurately in position; plumb; align, and brace securely until permanent anchors are set.
 - 1) At concrete or masonry construction, set frames and secure in place with machine screws and masonry anchorage devices. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - 2) Anchor bottom of frames to floors through floor anchors with threaded fasteners.
 - 3) Field splice only at approved locations indicated on the shop drawings. Weld, grind, and finish as required to conceal evidence of splicing on exposed faces.
 - 4) Remove spreader bars only after frames are properly set, plumbed, and secured but before the door is hung and hardware installed.
 - 2. At fire-rated openings, comply with NFPA 80 and the labeling service for installation.
 - 3. Existing Frames (Salvaged from Alteration Work): Install salvaged existing frames in locations indicated.
- C. Doors:
 - 1. Non-Fire Rated Doors: Fit non-fire-rated doors accurately in their respective frames, with the following clearances:
 - a. Jambs and Head: 3/32 inch (2 mm).
 - b. Meeting Edges, Pairs of Doors: 1/8 inch (3 mm).

- c. Bottom: 3/8 inch (9 mm), if no threshold or carpet.
 - d. Bottom: 1/8 inch (3 mm), at threshold or carpet.
 - 2. Fire-Rated Doors: Comply with NFPA 80 and the labeling service for installation.
 - 3. Smoke Control Doors: Comply with NFPA 105 and the labeling service for installation.
 - 4. Existing Doors (Salvaged from Alteration Work): Install salvaged existing doors in locations indicated.
- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow metal manufacturer's written instructions.
- 1. Secure stops with countersunk flat or oval head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (50 mm) o.c. from each corner.
- E. Apply hardware in accordance with hardware manufacturer's instructions and Section 087100 "Door Hardware." Drill and tap for machine screws as required. Do not use self tapping sheet metal screws. Adjust door installation to provide uniform clearance at head and jambs, and to contact stops uniformly. Adjust hardware items just prior to final inspection. Leave work in complete and proper operating condition.
- 1. Field cut existing hollow metal doors and frames indicated to receive new hardware. Field cutting shall be executed in a workmanlike manner and shall not void the existing door and frame labeling.
- 3.2 ADJUSTING AND CLEANING
- A. Final Adjustments: Check and readjust operating hardware items just before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including doors or frames that are warped, bowed, or otherwise unacceptable.
 - B. Factory Applied Sheet Steel Coated Touchup: After installation, repair surfaces of doors and frames that have rusted, or have had their prime coat damaged, by sanding smooth the damaged or rusted areas. After sanding apply a metal primer that is compatible with the factory applied finish.
 - 1. Finish Painting: Refer to Section 099123, Interior Painting.
 - C. Remove and replace defective work, including doors or frames that are warped, bowed, or otherwise defective.
 - D. Institute protective measures required throughout the remainder of the construction period to ensure that the hollow metal doors and frames will be without damage or deterioration, at time of Substantial Completion.

END OF SECTION

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes access doors and frames.

1.2 COORDINATION

- A. Verification: Obtain specific locations and sizes for required access doors from trades requiring access to concealed equipment, and where shown on the drawings, and indicate on schedule specified in "Submittals" Article.

1.3 ACTION SUBMITTALS

- A. Product Data: Submit product data for each type of access door and frame indicated. Include construction details relative to materials, individual components and profiles, finishes, and fire ratings (if required) for access doors and frames.
- B. Sustainable Design Submittals: Refer to Division 01 Section "Sustainable Design Requirements."

1.4 INFORMATIONAL SUBMITTALS

- A. Embodied Carbon Submittals: Refer to Section 018133 "Sustainable Design Requirements - Embodied Carbon."
- B. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items with concealed framing, suspension systems, piping, ductwork, and other construction. Show the following:
 - 1. Method of attaching door frames to surrounding construction.
 - 2. Ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim.
- C. Schedule: Provide complete door and frame schedule, including types, general locations, sizes, construction details, latching or locking provisions, and other data pertinent to installation.

1.5 QUALITY ASSURANCE

- A. Single-Source Responsibility: Obtain access doors of each type for entire project from one source from a single manufacturer.

- B. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 and that are labeled and listed by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction per test method indicated.
 - 1. Vertical Access Doors: NFPA 252 or UL 10B.
- C. Size and Location Verification: Determine specific locations and sizes for access doors needed to gain access to concealed equipment, and indicate on schedule.

PART 2 - PRODUCTS

2.1 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2.2 ACCESS DOORS AND FRAMES

- A. Flush, Insulated, Fire-Rated Access Doors and Trimless Frames : Fabricated from steel sheet.
 - 1. Locations: Gypsum board wall surfaces indicated to be fire rated.
 - 2. Fire-Resistance Rating: One and one-half hours.
 - 3. Temperature Rise Rating: 250 deg F (139 deg C) at the end of 30 minutes.
 - 4. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal.
 - 5. Frame: Sheet metal with drywall bead.
 - 6. Hinges: Continuous piano hinge.
 - 7. Automatic Closer: Spring type.
 - 8. Latch: Self-latching bolt operated by knurled knob with interior release.
 - 9. Products: One of the following:
 - a. Acudor Products, Inc.; FW-5050-DW Fire Rated for Drywall - Insulated.
 - b. Larsen's Industries, Inc.; L-FRAP.
 - c. Milcor; Style UFR-DW.
 - d. Nystrom, Inc.; IW Series.
- B. Flush Access Typical Doors and Trimless Frames for Vertical Surfaces : Fabricated from steel sheet.
 - 1. Locations: Gypsum board wall surfaces.
 - 2. Door: Minimum 14 gauge 0.067 inch (1.7 mm) thick sheet metal, set flush with surrounding finish surfaces.

3. Frame: Minimum 16 gauge 0.053 inch (1.3 mm) thick sheet metal with drywall bead.
 4. Hinges: Continuous concealed type.
 5. Latch: Flush, screwdriver- operated cam latch of number required to hold door in flush, smooth plane when closed.
 6. Products: One of the following:
 - a. Acudor Products, Inc.; DW-5040 Flush for Drywall.
 - b. Larsen's Industries, Inc.; Model L-DWC.
 - c. Milcor; Style DW.
 - d. Nystrom, Inc.; NW Series.
- C. Flush Access Typical Doors and Trimless Frames for Horizontal Surfaces : Fabricated from glass fiber reinforced gypsum.
1. Locations: Gypsum board ceiling surfaces.
 2. Door: Minimum 1/8 inch (3 mm) thick glass fiber reinforced gypsum, with radiused corners, set flush with surrounding gypsum wallboard finish surfaces.
 3. Frame: Minimum 1/8 inch (3 mm) thick glass fiber reinforced gypsum, with tapered square edge.
 4. Hinges and Latch: None, lay-in manual push up type.
 5. Product:
 - a. Acudor Products, Inc.; GFRG Recessed Access Door for Drywall Ceilings.
 - b. Chicago Metallic Ceiling Systems and Specialty Products: Glass Reinforced Gypsum Drywall Ceiling Access Doors.
 - c. Formglas, Inc.: Interior Ceiling Access Panel.
 - d. IntexForms Inc.; Lift & Shift Access Panel Radius Door Corners.
 - e. Wind-Lock; Stealth Access Panels.
- D. Flush Access Doors and Frames with Exposed Trim : Fabricated from steel sheet.
1. Locations: Ceramic-tile wall surfaces.
 2. Door: Minimum 14 gauge (0.067 inch) (1.7 mm) thick sheet metal, set flush with exposed face flange of frame.
 3. Frame: Minimum 16 gauge (0.053 inch) (1.3 mm) thick sheet metal with 1-inch- (25-mm-) wide, surface-mounted trim.
 4. Hinges: Continuous piano hinge.
 5. Latch: Flush, screwdriver-operated cam latch of number required to hold door in flush, smooth plane when closed.
 6. Products: One of the following:
 - a. Acudor Products, Inc.; UF-5000 Universal Flush Access Door.
 - b. Larsen's Industries, Inc.; Model L-MPG.
 - c. Milcor; Style M.
 - d. Nystrom, Inc.; NT Series.

2.3 FABRICATION

- A. General: Provide access door assemblies manufactured as integral units ready for installation.
- B. Steel Access Doors: Fabricate units of continuous welded steel construction. Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
 - 1. Provide special sized access doors where required or requested.
- C. Glass Fiber Reinforced Gypsum Doors: Fabricate units of monolithic glass fiber reinforced gypsum construction having a shell thickness of between 1/8 to 3/16 inch (3 to 4.8 mm) and weighing approximately 2 pounds per square foot. Edges of doors shall be rabbetted to overlap and rest on the frame.
 - 1. Provide special sized access doors where required or requested.
- D. Frames:
 - 1. Exposed Flanges: Nominal 1 to 1-1/2 inches (25 to 38 mm) wide around perimeter of frame for steel frames.
 - 2. Provide trimless carbon steel frames with drywall bead for installation in gypsum wallboard assembly, furnish perforated frames with drywall bead, securely attached to perimeter of frames, in size to suit thickness of gypsum panels indicated. Provide mounting holes in frames to attach frames to metal framing in drywall construction.
 - 3. Provide trimless glass fiber reinforced frames with tapered edges for taping and joint compound installation into gypsum wallboard ceiling assembly, in size to suit thickness of gypsum panels used.

2.4 CARBON STEEL FINISHES

- A. Surface Preparation: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- B. Apply shop primer to uncoated surfaces of metal fabrications. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's instructions for installation of access doors. Coordinate installation with work of other trades.

- B. Advise installers of other work about specific requirements relating to access door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.
- C. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- D. Install access doors flush with adjacent finish surfaces or recessed to receive finish material.
- E. Adjust doors and hardware after installation for proper operation.
- F. Remove and replace panels or frames that are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes aluminum-framed entrances and storefronts.
 - 1. Security system components may be incorporated into the door and frame openings of all aluminum-framed entrances and storefronts at the Owner's option. Cooperate with the Owner's security system contractors if the Owner chooses to incorporate security system components during the course of the Work.
- B. Section includes aluminum-framed entrances and storefronts. The aluminum-framed entrance and storefront work includes the following:
 - 1. Aluminum swing entrance doors and thermally broken framing, including hardware, stripping and thresholds.
 - 2. Aluminum sliding entrance doors, and thermally broken framing, including hardware, stripping and thresholds.
 - 3. Aluminum trim, drywall receivers, flashings, and similar items in conjunction with aluminum-framed entrance and storefronts.
 - 4. Painting and coating in conjunction with the above aluminum items.
 - 5. Internal steel and aluminum reinforcements for aluminum-framed entrances and storefronts.
 - 6. Internal and perimeter sealing, joint fillers, weeps, vents and gasketing systems for aluminum-framed entrances and storefronts.
 - 7. Anchors, shims, fasteners, inserts, expansion devices, accessories, support brackets and attachments and grout for aluminum-framed entrances and storefronts.
 - 8. Glass and glazing for aluminum-framed entrances and storefronts.
 - 9. Security system components may be incorporated into the door and frame openings of all aluminum-framed entrance and storefront work at the Owner's option. Cooperate with the Owner's security system contractors if the Owner chooses to incorporate security system components during the course of the Work.

1.2 REFERENCES

- A. Standards: Comply with the applicable provisions and recommendations of the following standards below, where standards conflict the more stringent shall apply:
 - 1. Aluminum Association (AA):
 - a. AA ASD1, "Aluminum Standards and Data, latest edition."
 - b. "The Aluminum Design Manual, Specifications and Guidelines for Aluminum Structures, Allowable Stress Design, Latest Edition.

- c. "The Aluminum Design Manual, Specifications and Guidelines for Aluminum Structures, LFRD, Latest Edition.
- 2. Fenestration & Glazing Industry Alliance (FGIA) (formerly American Architectural Manufacturers Association (AAMA):
 - a. AAMA CWM-19, "Curtain Wall Manual."
 - b. AAMA CW-10, "Care and Handling of Architectural Aluminum from Shop to Site."
 - c. AAMA SFM-1, "Aluminum Store Front and Entrance Design Guide Manual."
 - d. AAMA 501.2, "Specification for Field Check of Metal Curtain Walls for Water Leakage."
 - e. AAMA 611, "Anodized Architectural Aluminum."
 - f. AAMA 2603, "Voluntary Performance Requirements and Test Procedures for Pigmented Organic Coatings on Extruded Aluminum."
 - g. AAMA 2605, "Specification for Superior Performing Organic Coatings on Architectural Extrusions and Panels."
 - h. AAMA TIR-A8, "Structural Performance Poured and Debridged Framing Systems."
 - i. AAMA TIR-A9-201004, "Design Guide for Metal Cladding Fasteners."
 - j. AAMA QAG-1, "Quality Assurance Processing & Monitoring Guide for Poured and Debridged Polyurethane Thermal Barriers."
 - k. AAMA QAG-2, "Quality Assurance Processing & Monitoring Guide for Polyamide Thermal Barriers."
 - l. AAMA CW-12, Structural Properties of Glass.
- 3. American Institute of Steel Construction (AISC), "Steel Construction Manual," Current Edition.
- 4. American Society for Testing and Materials (ASTM):
 - a. ASTM C 1401, "Standard Guide for Structural Sealant Glazing."
 - b. ASTM E 283, "Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences Across the Specimen."
 - c. ASTM E 330, "Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference."
 - d. ASTM E 331, "Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference."
 - e. ASTM E 329, "Standard Specification for Agencies Engaged in Construction Inspection, Testing, or special Inspection."•
 - f. ASTM E 1300, "Standard Practice for Determining Load Resistance of Glass in Buildings."
 - g. ASTM E 1886, "Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials."
 - h. ASTM E 1996, "Standard for Performance of Exterior Windows, Glazed Curtain Walls, Doors and Storm Shutters Impacted by Windborne Debris in Hurricanes."

5. American Society of Civil Engineers (ASCE), ASCE 7 Minimum Design Loads for Buildings and Other Structures.
6. National Association of Architectural Metal Manufacturers (NAAMM), "Metal Finishes Manual."
7. Association for Materials Protection and Performance (AMPP) (formally Steel Structures Painting Council (SSPC): "Steel Structures Painting Manual, Vol. 2, Systems and Specifications."
8. ANSI Z97.1 and Federal Standard 16 CFR 1201, Consumer Product Safety Commission (CPSC): "Safety Standard for Architectural Glazing Materials," as published in the Code of Federal Regulations (CFR). Comply with the applicable requirements of the laws, codes, ordinances and regulations of Federal and Municipal authorities having jurisdiction, wherever requirements conflict the more stringent shall be required. Obtain approvals from all such authorities. As a minimum provide safety glazing complying with ANSI Z97.1 for Category A performance and 16 CFR Part 1201 for Category II performance.
9. Welding Standards: Welding shall be performed by skilled and qualified mechanics. Welding shall be performed in accordance with the applicable provisions of AWS D1.1 "Structural Welding Code - Steel" and AWS D1.2, "Structural Welding Code--Aluminum."
10. Builders Hardware Manufacturers Association (BHMA):
 - a. ANSI/BHMA A156.10, "Power Operated Pedestrian Doors."
 - b. ANSI/BHMA A156.19, "Power Assist and Low Energy Power Operated Doors."
 - c. ANSI/BHMA A156.27, "Power and Manual Operated Revolving Pedestrian Doors."
11. Underwriters Laboratories (UL): Provide power door operators that comply with UL 325.
12. National Fenestration Rating Council (NFRC):
 - a. NFRC 100, "Procedure for Determining Fenestration Product U-Factors."
 - b. NFRC 200, "Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence."
 - c. NFRC 300, "Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems."

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Prior to the start of the aluminum-frame entrance and storefront work, and at the Contractor's direction, meet at the site and review the installation procedures and coordination with other work. Meeting shall include Contractor, Owner, Architect, aluminum-framed entrance and storefront installer, sealant installer, as well as any other subcontractors or material technical service representatives whose work, or products, must be coordinated with the aluminum-framed entrance and storefront work.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: Submit shop drawings showing scaled elevations, plans, and sections of the aluminum entrance and storefront work. Full-scale sections shall be prepared and submitted for details of the assemblies that cannot be shown in the elevations or sections. Include with shop drawings metal thickness of all metal components, glass thicknesses, locations and details of distraction markings, metal finishes, location and installation requirements of door hardware and reinforcements, and all other pertinent information as necessary or requested by the Architect to indicate compliance with the Contract Documents. Details of field connections, anchorage, concealed pivot blocking, and their relationship to the work of others shall be clearly indicated for the coordination of the work by other building trades. Details of fastening and sealing methods and product joinery shall be shown to ensure proper performance of the field installation. No work shall be fabricated until shop drawings for that work have been reviewed by Architect for fabrication.
1. Hardware Schedule: Organize schedule into sets based on hardware specified. Include name of item and manufacturer, and complete designation of every item required for each entrance door.
 2. Indicate routing of electrical conduit and dimensions and locations of cutouts in doors and frames to accept electric hardware devices.
 3. Highlight the general requirement for torqueing of bolts in the Shop Drawings and clearly state tightening torque values.

1.5 INFORMATIONAL SUBMITTALS

- A. Embodied Carbon Submittals: Refer to Section 018133 "Sustainable Design Requirements - Embodied Carbon."

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Instructions: Submit an electronic copy of an assembled maintenance manual, describing the devices and procedures to be followed in cleaning, adjusting, and maintaining the aluminum-framed entrance and storefront work. Include information for maintaining operable doors, operating hardware, and replacing weather stripping.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Subcontract the aluminum-framed entrance and storefront work to a firm which is specialized in the erection of entrances and storefronts and who has successfully installed work similar in design and extent to that required for the Project, in not less than three projects of similar scope to the satisfaction of the Architect, and whose work has resulted in construction with a record of successful in-service performance for a period of 10 years.

- B. Testing laboratories shall be specifically qualified to conduct laboratory and field performance tests required by these specifications and acceptable to the Architect.
- C. Pre-construction Sealant Compatibility and Adhesion Testing: Test results confirming compatibility and adhesion are mandatory for all concealed and exposed sealant materials in contact with exterior glazing, stone, precast, other sealants, flashings, metal framing, and shims prior to full size sample installation construction. Refer to Section 079200 "Joint Sealants" for specific testing requirements, and anticipated lead time necessary to perform testing.
- D. Sample Installations:
 - 1. General: Sample installations will be used as a standard for judging acceptability of work for the Project. Replace unsatisfactory work as directed. Maintain sample installations during construction as a standard for judging acceptability of the exterior wall work. Properly finished, maintained, and performing sample installations shall be retained as a portion of the completed work.
 - 2. Size: Provide full sized sample installations to the extent indicated on the Drawings, or if not indicated, as directed by the Architect. Sample installations shall be built on site complete with all glass, aluminum framing, adjacent cladding materials, anchors, connections, flashings, sealants, and joint fillers as accepted on the final shop drawings. Do not take special precautions or use techniques that do not represent those to be used on the work. Do not enclose the interior side of the wall with interior finishes and insulation materials.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with the applicable provisions of AAMA CW-10, "Care and Handling of Architectural Aluminum from Shop to Site" for the care and handling of aluminum-framed entrance and storefront work from shop to site.
- B. All components of the aluminum-framed entrance and storefront work shall be identified after fabrication by marks clearly indicating their location in the building. Packaging of components shall be so selected to protect the components from damage during shipping and handling.
- C. Storage on Site:
 - 1. Store aluminum-framed entrance and storefront components in a location and in a manner to avoid damage to the components. Stacking shall be done in a way which will prevent bending, excessive pressure, abrasion or other permanent damage of the component and its finished surfaces.
 - 2. Store aluminum-framed entrance and storefront components and materials in a clean, dry location, away from uncured concrete, masonry work, sprayed on fireproofing work, and other construction activities. Cover with non-staining waterproof paper, tarpaulin, or polyethylene sheeting in a manner that will permit circulation of air inside the covering.

- D. Keep handling on site to a minimum. Exercise particular care to avoid damage to finishes of metals.

1.9 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of supporting structure by field measurements before fabrication so that the entrance and storefront work will be accurately designed, fabricated and fitted to the structure. Indicate measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work. Use Contractor's lines and benchmarks as a basis for measurements.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating entrance and storefront work without field measurements. Coordinate supporting structure construction to ensure actual dimensions correspond to established dimensions.
- B. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to, power supplies, fire alarm system and detection devices, access control system, security system, building control system.

1.10 WARRANTY

- A. Special Warranty: Submit a **5-year** written warranty, beginning from date of substantial completion, and executed by the Contractor, manufacturer and the aluminum-framed entrance and storefront installer agreeing to repair or replace components of entrance and storefront systems that develop defects in materials or workmanship within the specified warranty period. Defects include, structural failures, sealant failures, deterioration of metals, metal finishes, and other materials beyond normal weathering, failure of operating components to function properly, uncontrolled water leakage, uncontrolled air leakage, and any other evidence of failure or deterioration of the aluminum-framed entrance and storefront work to meet performance requirements.
- B. Warranty; Anodized Coatings: Submit a warranty for a period of 3 years, beginning from date of substantial completion, warranting that the anodized aluminum will not develop excessive fading or excessive non-uniformity of color or shade, and will not crack, peel, pit, or corrode; all within the limits defined as follows:
 - 1. "Excessive Fading" means a change in appearance which is perceptible and objectionable as determined by the Architect when viewed visually in comparison with the original color range samples.
 - 2. "Excessive Non-Uniformity" means non-uniform fading during the period of the warranty to the extent that adjacent panels have a color difference greater than the original acceptable range of color.
 - 3. "Will Not Pit or Otherwise Corrode" means there shall be no pitting or other type of corrosion discernable from a distance of 10 feet (3000 mm), resulting from the natural elements in the atmosphere at the Project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Manufacturer Qualifications:** The drawings and specifications are based on matching the existing storefront system. Contractor to verify. The basis-of-design is based on Kawneer Trifab VG 450 framing systems with 1-3/4" sightlines with 4-1/2" sightline base. Color and finish shall match the adjacent existing storefront system. Award the fabrication of aluminum framed entrances and storefront components to a single firm specializing in the fabrication of aluminum framed entrances and storefront components who has successfully produced work similar in design and extent to that required for the project, in not less than three projects of similar scope to the satisfaction of the Architect, and whose work has resulted in construction with a record of successful in-service performance for a period of 5 years. The fabricator shall have sufficient production capacity, have organized quality control and testing procedures, and published written and illustrated installation manuals, to produce and properly install the aluminum framed entrances and storefront assemblies required without causing delay in progress of the Work.
1. Other manufacturers capable of producing aluminum framed entrances and storefront systems meeting the performance requirements include the following:
 - a. EFCO Corporation.
 - b. Moduline Division of Oldcastle Building Envelope.
 - c. TRACO div. of Kawneer Company, Inc.
 - d. YKK AP America Inc.
 - e. Graham Architectural Products Corp.
 2. **Source Limitations:** Obtain aluminum framed entrances and storefronts from single source from single manufacturer.

2.2 PERFORMANCE CRITERIA

- A. **Air Leakage:**
1. **Typical Conditions:** Air leakage through each entrance and storefront assembly shall not have exceeded 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of fixed wall area when tested in accordance with ASTM E 283 at a static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).
 2. **Swinging Doors:** Air leakage through each swinging entrance door shall not have exceeded 1.0 cfm/sq. ft. (5.0 L/s per sq. m) of surface area when tested in accordance with ASTM E 283 at a static-air-pressure difference of 1.57 lbf/sq. ft. (75 Pa).
- B. **Water Penetration:**

1. Water penetration in this specification is defined as the appearance of uncontrolled water, other than condensation, on any indoor face of any part of the wall.
 2. Provision shall be made to drain to the exterior face of the wall any water entering the system.
 3. No uncontrolled water penetration shall have occurred when each storefront assembly (each fixed storefront wall) was tested in accordance with the ASTM E 331 for one 15 minute cycle at a static pressure difference of 12 lbf/sq. ft. (600 Pa) minimum.
- C. Building Frame Movement: Design, fabricate and install aluminum-framed entrances and storefronts to withstand building movements including thermal movements, loading deflections, shrinkage, creep and similar movements. Thermal movements shall be as specified above. Building frame deflections, shrinkage, creep and other movements are available from the structural engineer.
- D. Condensation Resistance: Design, fabricate and install the aluminum framed entrance and storefront systems to prevent excessive condensation on the indoor exposure of the wall with the mechanical system functioning under normal operating conditions. A computer generated thermal analysis for each primary entrance and storefront system showing temperature gradients through each component of the glazed aluminum entrance and storefront and the location of the dewpoint shall be submitted with the shop drawing package. Excessive condensation is defined as the accumulation of uncontrolled condensate flowing from the entrance and storefront at any location, or visible ice, frost, or water on more than 5 percent of the area of any module of the exterior wall.
- E. Thermal Transmittance: Design, fabricate and install the aluminum framed entrance and storefront assemblies with the assembly U-factor maximum to comply with ASHRAE 90.1 and the IECC for the project specific geographic location of the building project when tested according to NFRC 100. A computer generated thermal analysis for each primary entrance and storefront system; showing temperature gradients through each component of the glazed aluminum entrance and storefront and the location of the dewpoint shall be submitted with the shop drawing package. Indoor humidity, and indoor and outdoor temperature parameters for the project are available from the mechanical engineer.
- F. Solar Heat-Gain Coefficient: Unless otherwise indicated in the glass schedules, provide glass for aluminum framed entrance and storefront assemblies with a assembly SHGC maximum to comply with ASHRAE 90.1 and the IECC for the project specific geographic location of the building project as determined according to NFRC 200 procedures.

- G. Distraction Markings: Comply with the applicable requirements of the local code having jurisdiction applicable to distraction markings for glass at glass doors and sidelights. Where separation bars, muntin bars, door pull or push bars, or equivalent are not indicated provide and locate markings of each glass lite required to be marked in accordance with the requirements of the local codes having jurisdiction and as accepted through sample submissions and shop drawings. Where no specific distraction marking design is provided utilize the standardized distraction marking details provided by the Architect.
- H. Design Modifications:
1. Submit design modifications necessary to meet the performance requirements and field coordination.
 2. Variations in details or materials shall not adversely affect the appearance, durability or strength of components.
 3. Maintain the general design concept without altering size of members, profiles and alignment.

2.3 MATERIALS

- A. Aluminum: Conform to the requirements published in AA "Aluminum Standards and Data," referenced ASTM standards and the following. All aluminum extrusions shall be manufactured to dimensional tolerances so as to eliminate any edge projection or misalignment at joints. Unless otherwise specified, provide alloy and temper as required to suit performance requirements and finish(es) indicated. Provide concealed extruded bars, rods, shapes and tubes in alloys as recommended by the fabricator to join or reinforce assembly of exposed aluminum components.
1. Welding Rods and Bare Electrodes: AWS A5.10.
- B. Carbon Steel: For carbon steel components required to join, reinforce or support the assembly of aluminum components provide carbon steel conforming to ASTM A 36/A 36M for structural shapes, plates, and bars; ASTM A 1008/A 1008M for cold-rolled sheet and strip; or ASTM A 1011/A 1011M for hot-rolled sheet and strip.
1. Refer to Section 055000, Metal Fabrications, for carbon steel framing, embedments, anchors, and welding that is not primary building structure nor furnished by the entrance and storefront fabricator but is required to transmit live and deadloads from the entrance and storefront framing to the primary building structure.
- C. Glass and Glazing Materials: As specified in Section 088000 "Glazing."
- D. Thermal Isolators: Provide rigid plastic or nylon isolators of profile and hardness as recommended by the aluminum framed entrance and storefront manufacturer, and fabricated to a cross sectional profile to interlock with aluminum extrusions for thermal isolation of exterior window frame snap caps to interior window framing.

- E. Anchors and Fasteners: Fastener design for aluminum components shall be in accordance with the applicable provisions of the Aluminum Association Aluminum Design Manual AA-ADM1.
 - 1. Material:
 - a. Wet Zones: Series 300 stainless steel.
 - b. Dry Zones: Carbon steel complying with either ASTM F 3125 or SAE Grade 5.
 - 2. Anchor and Fastener Metal Alloy Types, Designations and Standards: Alloys as selected by fabricator to prevent corrosion with the components fastened. Self drilling self tapping fasteners shall only be used where not exposed to view.
 - 3. Do not use exposed anchors and fasteners, except for hardware application. For hardware application, use countersunk Phillips flat-head machine screws finished to match framing members or hardware being fastened, unless otherwise indicated.
 - 4. Where fasteners are subject to loosening or turn out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
- F. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123 or ASTM A 153 requirements.
- G. Concealed Flashing: Stainless steel complying with ASTM A 666, Type 304, and formed from 0.018 inch (0.457 mm) thick dead soft temper.

2.4 SEALING MATERIALS

- A. Concealed Sealing Materials: All sealing materials concealed within the entrances and storefronts (i.e. glass pockets, end dams, fastener heads, and internal gutters) shall be silicone, compatible with and adherent to each material it will be in contact with, as recommended by the manufacturer to fulfill performance requirements.
- B. Exposed Sealing Materials: All sealing materials exposed at entrance and storefront perimeter joints in contact with adjacent cladding materials: Silicone, refer to Section 079200 "Joint Sealants."

2.5 FABRICATION

- A. General: Fabricate the entrances and storefronts to the designs, shapes, and sizes shown using the materials specified and shown to produce assemblies that meet or exceed the performance criteria. To the greatest extent possible, complete fabrication, assembly, finishing, hardware applications and other work before shipment to Project site.
 - 1. Metal Wall Thickness: Provide shapes as shown and as required to suit the performance requirements but with wall thickness of not less than 1/8 inch (3 mm).
 - 2. Door Stile and Rail Dimensions:

- a. Bottomrails: Provide minimum 10 inch (254 mm) high one piece bottomrail unless otherwise indicated on the Drawings.
 - b. Stiles and Top Rail Dimensions: Medium stile; 2-1/8 inches (28 mm) wide. Confirm with Drawings.
 - c. Door Thickness: 1-3/4 inch (44.5 mm).
 - d. Preglaze door units to greatest extent possible, in coordination with installation and hardware requirements. Glazing, whether in factory or in field, shall be performed in accordance with Section 088000 "Glazing."
 - e. Fabricate all doors and frames to accommodate the swing direction shown.
3. Provide extruded aluminum entrance door inserts at door frames designed with bosses sized to receive selected door gasket.
- B. Glazing Stops and Gaskets: Provide continuous interior glazing stops with concealed fasteners for all doors and frames. Provide stops with hairline joints at corners. Provide stops with beveled, not square, shouldered profile unless otherwise shown.
- C. Glass Components: Provide holes and cutouts in glass to receive hardware and accessories before tempering glass. Drill, countersink, and chamfer holes using tooling, materials and methods which are selected and applied to prevent spalling of the cut glass surfaces at holes and cutouts. The internal surface of holes and cutouts shall be smooth with minimal roughness from drilling operations. Do not cut, drill, or make other alterations to glass after tempering.
 1. Fully temper glass using horizontal (roller-hearth) process and fabricate so, when installed, roll-wave distortion is parallel with bottom edge of door or lite.
 2. Heat Soaking: After tempering, expose 100% of all fabricated glass units to European Standard EN14179 heat soaking process to reduce the potential for inclusion related glass breakage.
 3. Factory assemble components and factory install hardware to greatest extent possible.
- D. Metal Components: Doors and frames shall be cut, reinforced, drilled and tapped in strict accordance with the printed door hardware manufacturer's templates and instructions. Provide solid stainless steel hardware reinforcements, securely fastened to doors and frames where door hardware is to be attached. Provide fixed pivot arm blocking for all doors hung on pivots do not use adjustable slide track type blocking.
 1. Security system components may be incorporated into the door and frame openings of all entrance doors and frames. Provide all cutouts required by the Owner's security system vendor and all prewiring for vendor provided security system devices. Wherever storefront and entrance framing components are to receive wiring provide unobstructed clear paths free of burrs and sharp objects with pull strings to facilitate wiring.
- E. Joints in Metal Work: All exposed work shall be carefully fitted and matched to produce continuity of line and design, with all joints, being accurately fitted for hairline contact and rigidly secured. Where additional rigidity or strength is required to satisfy the performance requirements reinforce entrance components with aluminum or carbon steel shapes, bars, and plates.

- F. Shop Assembly: As far as practicable, all fitting and assembly work shall be done in a fabrication shop.
 - 1. For exterior entrances, provide weepholes and internal water passages in the glazing framing recesses as recommended by the respective glass and framing manufacturers to conduct infiltrating water to the exterior. Provide weep baffles secured to inside of frame behind weepholes.
- G. Exposed Fasteners: Not permitted.
- H. Protection of Metals: Wherever dissimilar metals are in contact, except in the case of aluminum in contact with galvanized steel, zinc, separate such surfaces with a coating of zinc rich primer, bituminous paint, or separation gaskets as the condition requires. Wherever aluminum comes in contact with concrete surfaces separate such surfaces with a coating of zinc rich primer, bituminous paint, or separation gaskets as the condition requires.

2.6 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
- B. Finish Application:
 - 1. Apply anodized coatings to all exposed surfaces of storefront and entrance components.
 - 2. Extent of Coating Types:
 - a. Anodic Coatings: Except for exposed surfaces of exterior (weathering side) snap on exterior caps, metal panels, column covers, and the exposed interior surfaces of the main entry lobby ground floor storefront, apply anodized coatings to all exposed interior surfaces of storefront and entrance components.
- C. Appearance of Finished Work: During production, maintain large size color range samples for use in comparing against production material. Variations in appearance of abutting or adjacent pieces are acceptable if they are within the range of approved samples. Noticeable variations in the same piece are not acceptable.
- D. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

2.7 COATINGS FOR CONCEALED METAL SURFACES

- A. General: The following protective coatings shall be applied to surfaces of metals which are to be concealed in the construction:
 - 1. Coating for Carbon Steel: Hot dip galvanized, complying with ASTM A 123.

2. Coating for Aluminum, Carbon Steel, and Bronze: Where aluminum or carbon steel surfaces are to be in contact with each other or in contact with dissimilar materials such as masonry or concrete, and where hot dip galvanizing of carbon steel is incompatible with component parts because of galvanic action or component fabrication tolerances provide one of the following:
 - a. Bituminous Paint: Cold-applied, non-sagging, bituminous paint complying with ASTM D 1187. Apply in two coats for an overall minimum dry film thickness of 25 mils.
 - b. Zinc Rich Primer: Organic zinc-rich primer, complying with SSPC-Paint 20.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before beginning installation of the entrance and storefront work examine all parts of the existing building structural frame and the existing building cladding indicated to support the entrance and storefront work. Ensure that the existing swing door thresholds, existing swing doors, swing door framing and subframes have been completely removed with all projecting anchors cut off flush. Notify Contractor in writing, of any dimensions, or conditions, found which will prevent the proper execution of the entrance and storefront work, including specified tolerances. Use Contractor's offset lines and bench marks as basis of measurements.

3.2 PREPARATION

- A. Coordinate entrance and storefront work with the work of other Sections and provide items to be placed during the installation of other work at the proper time to avoid delays in the work.
- B. Place such items, including concealed overhead framing, accurately in relation to the final location of entrance and storefront components.

3.3 INSTALLATION

- A. General: Comply with manufacturer's written instructions for protecting, handling, and installing entrance and storefront systems. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight. Clean excess joint sealants from finished surfaces.

1. Cut and trim component parts of the entrance and storefront work during erection only with the approval of the manufacturer or fabricator, and in accordance with its recommendations. Restore finish completely to protect material and remove all evidence of cutting and trimming. Remove and replace members where cutting and trimming has impaired strength or appearance, as directed by Architect.
 2. Set components within the erection tolerances with uniform joints. Place components on shims and fasten to supporting substrates using bolts and similar fasteners. Use stainless steel shims at structural connections only. U shaped shims at structural connections are not permitted. Use aluminum, stainless steel, or high impact polystyrene shims at other connections.
 3. Do not erect components that are warped, deformed, bowed, dented, defaced or otherwise damaged as to impair its strength or appearance. Remove and replace members damaged in the process of erection.
 4. No holes or slots shall be burned, cut into, or field drilled in any building framing member without the written acceptance of the structural engineer.
 5. Install subsills in single piece lengths. Joints, where required, shall be placed at the maximum spacing allowed by the system manufacturer and sealed to result in a splice joint that is compliant with the manufacturers subsill splicing details. Fill anchor leg receptors at the splice joints as required by the system manufacturer. Spot heads of all fasteners with sealant.
 6. Attach and seal end dams at the ends of all subsills.
- B. Entrance and Storefront Framing: Install framing components plumb and true in alignment with established lines and grades without warp or rack of framing members.
- C. Install glazing to comply with requirements of Section 088000 "Glazing," unless otherwise indicated.
- D. Install perimeter sealant to comply with requirements of Section 079200 "Joint Sealants," unless otherwise indicated.
- E. Concealed Sealing Components: Apply sealant and gasket components that are integral to the entrance and storefront systems in strict accordance with the each component manufacturer's printed instructions. Before applying components remove all mortar, dust, dirt, moisture, and other foreign matter that will be deleterious to the intended performance of the component. Mask adjoining exposed surfaces to avoid spilling, dripping, dropping or other unintended contact of the sealing components onto adjacent exposed surfaces.
- 3.4 ERECTION TOLERANCES
- A. The entrance and storefront systems shall be fabricated and erected to accommodate the dimensional tolerances of the structural frame while providing the following as installed tolerances.

1. Variation from theoretical calculated position as located in plan or elevation in relation to established floors lines, column lines and other fixed elements of the structure, including variations from plumb, level, straight and member size: +/- 1/4 inch max in any 20'-0" (+/- 6 mm in any 6 m) run, column-to-column bay, or floor-to-floor height.
2. Alignment: Where surfaces abut in line, and where they meet at corners, limit offset from true alignment to 1/32 inch (.75 mm).
3. Variation from angle, or plumb, shown: +/- 1/8 inch max in any 10'-0" (+/- 3 mm in any 3 m) run or story height, non-cumulative.
4. Variation from slope, or level, shown: +/- 1/8 inch max in any 20'-0" (+/- 3 mm in any 6 m) run or column-to-column bay, non-cumulative.

3.5 ANCHORAGE

- A. Anchorage of the entrance and storefront work to the structure shall be in accordance with the accepted shop drawings.

3.6 WELDING

- A. Weld with electrodes and by methods recommended by manufacturer of material being welded, and in accordance with AWS D1.1 for concealed steel members.
- B. Welds and adjacent metal areas shall be thoroughly cleaned and coated with a single coat of bituminous paint.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing agency to perform field quality-control testing indicated. Conduct tests of each specified sample installation under the direction of the testing agency in the presence of the Owner, Architect, the Contractor, various component manufacturers and fabricators and the Installer for each system incorporated in the sample installation.

3.8 REMOVAL OF DEBRIS

- A. All debris caused by, or incidental to, the erection of the entrance and storefront work shall be removed from the site and disposed of legally.

3.9 CLEANING

- A. Clean metal surfaces promptly after installation, exercising care to avoid damage to factory finished exposed surfaces.

- B. Wash glass on both faces not more than 4 days prior to date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer. Remove excess glazing and sealant compounds, dirt, and other substances.
- C. Immediately remove any deleterious material from surfaces of aluminum.

3.10 PROTECTION

- A. Institute protective measures required throughout the remainder of the construction period to ensure that entrance and storefront work will be without damage or deterioration, other than normal weathering, at time of acceptance.

END OF SECTION

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes door hardware.

1.2 PRE-INSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to electrified door hardware including, but not limited to, the following:
 - 1. Inspect and discuss electrical roughing-in and other preparatory work performed by other trades.
 - 2. Review sequence of operation for each type of electrified door hardware.
 - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review required testing, inspecting, and certifying procedures.

1.3 ACTION SUBMITTALS

- A. Product Data: Submit product data including installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Sustainable Design Submittals: Refer to Division 01 Section "Sustainable Design Requirements."
- C. Samples: Submit samples of exposed door hardware for each type indicated below, in specified finish. Tag with full description for coordination with the Door Hardware Schedule.
 - 1. Door Hardware: As follows:
 - a. Locks and latches.
 - b. Operating trim.
 - c. Coat hooks.
 - 2. Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.

- D. Door Hardware Schedule: Submit door hardware schedule prepared by or under the supervision of door hardware supplier and signed by either a qualified Architectural Hardware Consultant or an Door and Hardware Consultant (DHC), Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware. The Architect's review of schedule shall neither be construed as a complete check nor shall it relieve the Contractor of responsibility for errors, deviations, or omissions from the specified requirements to provide complete door hardware for the project.
1. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening.
 - a. Organize door hardware sets in same order as in the Door Hardware Schedule.
 2. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware. Supply templates to door and frame manufacturer(s) to enable proper and accurate sizing and locations of cutouts for hardware. Detail conditions requiring custom extended lip strikes, or other special or custom conditions.
 - g. Door and frame sizes and materials.
 - h. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
 - 1) Sequence of Operation: Include description of component functions that occur in the following situations: authorized person wants to enter; authorized person wants to exit; unauthorized person wants to enter; unauthorized person wants to exit.
- E. Keying Schedule: Submit keying schedule prepared by or under the supervision of supplier, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

1.4 INFORMATIONAL SUBMITTALS

- A. Embodied Carbon Submittals: Refer to Section 018133 "Sustainable Design Requirements - Embodied Carbon."

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Submit maintenance data for each type of door hardware. Include final hardware and keying schedule.
- B. Warranties: Submit special warranties specified in this Section.
- C. Fire-Rated Door Assembly Testing: Submit a written record of each fire door assembly to the Owner to be made available to the Authority Having Jurisdiction (AHJ) for future building inspections.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Supplier Qualifications: Door hardware supplier, who has completed a minimum of three projects over the last five years which were similar in material, design and extent to that indicated for the project and which have resulted in construction with a record of successful in service performance, and who is or employs a qualified Architectural Hardware Consultant, available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
 - 1. Scheduling Responsibility: Preparation of door hardware and keying schedules.
- C. Source Limitations: Obtain each type of door hardware from a single manufacturer, unless otherwise indicated.
- D. Regulatory Requirements: Comply with the following:
 - 1. Provide hardware items complying with the applicable provisions for accessibility and usability by the disabled and handicapped in compliance with ABA Accessibility Standard.
 - 2. NFPA 101: Comply with applicable provisions for means of egress doors.
 - 3. Electrified Door Hardware: Listed and classified by Underwriters Laboratories, Inc. or by a testing agency acceptable to authorities having jurisdiction, as suitable for the purpose indicated.
- E. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by Underwriters Laboratories, Inc. for fire ratings indicated, based on testing according to NFPA 252. Provide only door hardware items that are identical to items tested by UL for the types and sizes of doors required. In case of conflict between type of hardware specified and type required for accessibility or fire protection, furnish type required by NFPA and UL. Doors indicated in fire rated partitions and walls shall be positive latching and self-closing, with smoke gaskets where required by applicable codes.

1. Wherever exit device hardware is required on doors, comply with UL 305. Furnish hardware to door manufacturer for installation at factory. Provide supplementary label, "Fire Exit Hardware," on each exit device to certify that panic hardware has been panic load tested with door.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

1.8 COORDINATION

- A. Coordinate layout and installation of recessed pivots and closers with floor construction.
- B. Templates: Furnish templates and door hardware schedules, coordinated for the application of door hardware items with door and frame details, to door opening fabricators and trades performing door opening work to permit the preparation of doors and frames to receive the specified door hardware. Where the door hardware item scheduled is not adaptable to the finished size of door opening members requiring door hardware, submit an item having a similar operation and quality to the Architect for review. Each door hardware item shall be fabricated to templates.
- C. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to, power supplies, fire alarm system and detection devices, access control system, security system, building control system.
- D. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.
 1. Existing Hardware (Salvaged from Alteration Work): All hardware from existing doors and frames shall be salvaged and returned to the location directed by the Owner's representative.

1.9 WARRANTY

- A. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
 1. Faulty operation of door hardware.
 2. Deterioration of metals, metal finishes, and other materials beyond normal use.

- B. Warranty Period for Electromagnetic Locks: Five years from date of Substantial Completion.
- C. Warranty Period for Manual Closers: Ten years from date of Substantial Completion.
- D. Warranty Period for Concealed Floor Closers: Five years from date of Substantial Completion.
- E. Warranty Period for Exit Devices: Five years from date of Substantial Completion.
- F. Warranty Period for Other Hardware: Two years from date of Substantial Completion.
- G. Warranty for Mortised Mechanical Lock and Latchsets: Ten years from date of Substantial Completion.
- H. Warranty for Heavy Duty Cylindrical Mechanical Lock and Latchsets: Seven years from date of Substantial Completion.
- I. Warranty for Automatic Door Operators: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in this Section, door hardware sets are keyed to each scheduled door in the door and frame schedule, and the Door Hardware Schedule.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturer's products.
 - 2. The hardware supplier shall review each hardware set and compare it with the door types, details, and sizes as shown and verify each hardware item for function, hand, backset, and method of fastening through shop drawing submittals.

2.2 HINGES AND PIVOTS

- A. Butt Hinge Products and Manufacturers:
 - 1. Standard Weight, Plain Bearing, 5 Knuckle, Steel: Complying with BHMA A156.1 A8133, one of the following:
 - a. 1279; Hager Companies (HAG).
 - b. T2714; McKinney Products Company (MCK).
 - c. F179; Best division of Dormakaba (BE).
 - d. 5PB1; Ives (IVS).

2. Standard Weight, Ball Bearing, 3 Knuckle, Steel: Complying with BHMA A156.1 A8112, one of the following:
 - a. AB700; Hager Companies (HAG).
 - b. TB714; McKinney Products Company (MCK).
 - c. CB1900R; Best division of Dormakaba (BE).
 - d. 3CB1; Ives (IVS).
3. Heavy Weight, Ball Bearing, 3 Knuckle, Steel: Complying with BHMA A156.1 A8111, one of the following:
 - a. AB750; Hager Companies (HAG).
 - b. TB5786; McKinney Products Company (MCK).
 - c. CB1901R; Best division of Dormakaba (BE).
 - d. 3CB1HW; Ives (IVS).
4. Heavy Weight, Ball Bearing, 3 Knuckle, Stainless Steel: Complying with BHMA A156.1 A5111, one of the following:
 - a. AB850; Hager Companies (HAG).
 - b. TB5386-32D; McKinney Products Company (MCK).
 - c. CB1961R (US32D); Best division of Dormakaba (BE).
 - d. 3CB1HW Stainless Steel; Ives (IVS).
5. Standard Weight, Ball Bearing, 5 Knuckle, Steel: Complying with BHMA A156.1 A8112, one of the following:
 - a. BB1279; Hager Companies (HAG).
 - b. TB2714; McKinney Products Company (MCK).
 - c. FBB179; Best division of Dormakaba (BE) .
 - d. 5BB1; Ives (IVS).
6. Standard Weight, Ball Bearing, 5 Knuckle, Stainless Steel: Complying with BHMA A156.1 A8112, one of the following:
 - a. BB1191; Hager Companies (HAG).
 - b. TB2314; McKinney Products Company (MCK).
 - c. FBB191; Best division of Dormakaba (BE).
 - d. 5BB1; Ives (IVS).
7. Heavy Weight, Ball Bearing, 5 Knuckle, Steel: Complying with BHMA A156.1 A8111, one of the following:
 - a. BB1168; Hager Companies (HAG).
 - b. T4B3786; McKinney Products Company (MCK).
 - c. FBB168; Best division of Dormakaba (BE).
 - d. 5BB1HW; Ives (IVS).
8. Heavy Weight, Ball Bearing, 5 Knuckle, Stainless Steel: Complying with BHMA A156.1 A5111, one of the following:

- a. BB1199; Hager Companies (HAG).
 - b. T4B3386-32D; McKinney Products Company (MCK).
 - c. FBB199 (US32D); Best division of Dormakaba (BE).
 - d. 5BB1HW Stainless Steel; Ives (IVS).
9. Heavy Weight, Ball Bearing, 5 Knuckle, Steel, Concealed Electric 24V, 8 Wire: Complying with BHMA A156.1 A8111, one of the following:
- a. BB1168 x ETW-8; Hager Companies (HAG).
 - b. T4B3786 x CC-8; McKinney Products Company (MCK).
 - c. CEFBB168-58; Best division of Dormakaba (BE).
 - d. 5BB1HW x TW8; Ives (IVS).
10. Heavy Weight, Ball Bearing, 5 Knuckle, Stainless Steel, Concealed Electric 24V, 8 Wire: Complying with BHMA A156.1 A5111, one of the following:
- a. BB1199 x ETW-8; Hager Companies (HAG).
 - b. T4B3386-32D x CC-8; McKinney Products Company (MCK).
 - c. CEFBB199 (US32D)-58; Best division of Dormakaba (BE).
 - d. 5BB1HW Stainless Steel x TW8; Ives (IVS).
11. Standard Weight, Ball Bearing, 5 Knuckle, Steel, Concealed Electric 24V, 8 Wire: Complying with BHMA A156.1 A8112, one of the following:
- a. BB1279 x ETW-8; Hager Companies (HAG).
 - b. TB2714 x CC-8; McKinney Products Company (MCK).
 - c. CEFBB179-58; Best division of Dormakaba (BE) .
 - d. 5BB1 x TW8; Ives (IVS).
12. Standard Weight, Ball Bearing, 5 Knuckle, Stainless Steel, Concealed Electric 24V, 8 Wire: Complying with BHMA A156.1 A8112, one of the following:
- a. BB1191 x ETW-8; Hager Companies (HAG).
 - b. TB2314 x CC-8; McKinney Products Company (MCK).
 - c. CEFBB191-58; Best division of Dormakaba (BE).
 - d. 5BB1 x TW8; Ives (IVS).
- B. Pivot and Pivot Hinge Products and Manufacturers:
1. Offset Pivots:
- a. Offset Pivot with Jamb Mounted Bottom Pivot: Mortised mounted, handed, 3/4 inch (19 mm) offset pivot set and composed of a head mounted top pivot and jamb mounted bottom pivot. Furnish with extended spindles. Complying with BHMA A156.4 C07131.
 - 1) Model 195 Offset Hung Pivot Set; Norton Rixson (RIX).
 - 2) 7215 Pivot Set; Ives (IVS).
 - 3) 0195 Offset Pivot Set; Architectural Builders Hardware Mfg., Inc. (ABH).

- b. Offset Pivot with Floor Mounted Bottom Pivot: Mortised mounted, handed, 3/4 inch (19 mm) offset pivot set and composed of a head mounted top pivot and floor mounted bottom pivot. Furnish with extended spindles. Complying with BHMA A156.4 C07162.
 - 1) Model 117 Offset Hung Pivot Set; Norton Rixson (RIX).
 - 2) 7226 Pivot Set; Ives (IVS).
 - 3) 0117 Offset Pivot Set; Architectural Builders Hardware Mfg., Inc. (ABH).
 - 4) Model 147 Offset Hung Pivot Set; Norton Rixson (RIX).
 - 5) 7226 Pivot Set; Ives (IVS).
 - 6) 0147 Offset Pivot Set; Architectural Builders Hardware Mfg., Inc. (ABH).
- c. 1/4 inch (6 mm) Offset Pivot with Jamb Mounted Top and Bottom Pivots: Mortised mounted, handed, 1/4 inch (6 mm) offset pivot set composed of a frame mounted top pivot and frame mounted bottom pivot. Complying with BHMA A156.1 A8782.
 - 1) 327; Best division of Dormakaba (BE).
 - 2) 615; Hager Companies (HAG).
- 2. Center Pivots: Mortised mounted, non-handed, center pivot set and composed of a head mounted top pivot and floor mounted bottom pivot. Furnish with extended spindles. Complying with BHMA A156.4 C07032.
 - a. Model 370 Center Hung Pivot Set; Norton Rixson (RIX).
 - b. 7255 Pivot Set; Ives (IVS).
 - c. 0370 Center Hung Pivot Set; Architectural Builders Hardware Mfg., Inc. (ABH).
 - d. Model 370 Center Hung Pivot less standard top pivot x 345 Top Pivot; Norton Rixson (RIX).
- 3. Electrified Center Pivots: Concealed electric, 3 amp rated for Class II wiring applications, 22 gauge insulated four wire, mortised mounted, non-handed, center pivot set with sealed bearings for protection against debris and composed of a head mounted electric top pivot and floor mounted bottom pivot. Furnish with extended spindles. Complying with BHMA A156.4 C07032 Modified.
 - a. Model 370 Center Hung Pivot less standard top pivot x E-H340 Top Pivot; Norton Rixson (RIX).
- 4. Intermediate Pivots: Mortised jamb mounted, non-load bearing, handed, 3/4 inch (19 mm) offset intermediate pivots. Complying with BHMA A156.4 C07321.
 - a. Model M19 x 3/4 Intermediate Offset Pivots; Norton Rixson (RIX).
 - b. 7200 INT Series Pivots; Ives (IVS).
 - c. 019 Intermediate Pivot; Architectural Builders Hardware Mfg., Inc. (ABH).

5. Electrified Intermediate Pivots: Concealed electric, low voltage, minimum 28 gauge insulated four wire, mortised jamb mounted, non-load bearing, handed, 3/4 inch (19 mm) offset intermediate pivots with sealed bearings for protection against debris. Complying with BHMA A156.4 C07321 minimum vertical adjustment of 1/8 inch (3.2 mm).
 - a. Model E-M19 x 3/4 Intermediate Offset Pivots; Norton Rixson (RIX).
 - b. 7200PT Series Power Transfer Pivots; Ives (IVS).
 - c. E019 Intermediate Pivot; Architectural Builders Hardware Mfg., Inc. (ABH).

C. Invisible Hinges Products and Manufacturers:

1. Full mortised, invisible "Soss" hinges as manufactured by SOSS Door Hardware, An Allegion Brand, and specifically manufactured for door thickness indicated and fabricated from high strength plated steel, heavy duty zinc alloy castings, and non-removable riveted hinge pins. Each hinge shall be engineered for smooth performance with laminated link construction supplemented by anti-friction materials that reduce friction for smooth, free hinge operation. Complying with BHMA A156.9, B01501.
 - a. Hinge Quantity: Provide hinge quantity as recommended by hinge manufacturer based on door width, weight, thickness, door material, and hinge cup selection.
2. Full mortised, invisible type hinges and specifically manufactured for door thickness indicated and fabricated from steel, and non-removable pins. Each hinge shall be engineered for smooth performance with maintenance free slide bearing construction supplemented by anti-friction materials that reduce friction for smooth, free hinge operation, adjustable in 3 dimensions, UL Listed for 20 minute fire doors.
 - a. Hinge Quantity: Provide hinge quantity as recommended by hinge manufacturer based on door width, weight, thickness, door material.
 - b. One of the following:
 - 1) Tectus TE 527 3D; Simonswerk.
 - 2) RY-120 Concealed Hinges; RocYork.

D. General Hinge and Pivot Characteristics: Where door jamb or trim projects to such an extent that the width of leaf specified will not allow the door to clear such frame or trim, furnish hinges and pivots with leaves of sufficient width to clear. Hinges and pivots shall be template hinges and in accordance with door and frame material requirements.

1. Pivot Hinge Special Layout: At deep reveals where door frame profiles will not permit the use of a standard top pivot (e.g. deep reveals, narrow frames, full height doors) furnish top pivots less top leaf with specially designed and fabricated pivot block (Rixson Special Layout 102).

2. Pivot Hinge Special Layout: Where door frame and door face profiles are flush and will not permit the use of a standard 3/4 inches (19 mm) offset top pivot furnish top pivots with 1-1/2 inches (38 mm) offset top pivot jamb portion (Rixson Special Layout SP 1124 1-1/2").
- E. Butt Hinge and Offset Pivot Hinge Quantity: Provide the following, unless otherwise indicated:
1. Two Hinges: For doors with heights up to and including 60 inches (1524 mm).
 2. Three Hinges: For doors with heights of greater than 60 inches (1524 mm) to and including 90 inches (2286 mm).
 3. Four Hinges: For doors with heights greater than 90 inches (2286 mm) to and including 120 inches (3048 mm).
 4. Provide 4 hinges, plus 1 hinge for every 30 inches (750 mm) of door height greater than 120 inches (3048 mm).
- F. Butt Hinge Sizes: 4-1/2 inches (114 mm) h. x 4 inches (102 mm) or 4-1/2 inches (114 mm) w. for doors up to and including 36 inches (914 mm) in width; 5 inches (127 mm) h. x 4 inches (102 mm) or 4-1/2 inches (114 mm) w. for doors greater than 36 inches (914 mm) in width.
- G. Hinge Characteristics: Full mortise type with square corners. All butt hinges are to have non-rising pins for interior hinges. Provide non-removable pins (NRP) and security studs (SH or SSF) at interior butt hinges for security doors where scheduled. Provide only steel bodied butt and pivot hinges at labeled doors. All butt hinges shall be furnished with button tips. Provide heavy weight, ball bearing, hinges at doors 40 inches (1016 mm) and greater in width.
- H. Electrified Functions for Hinges and Pivots: Furnish fully concealed circuit, tamper resistant, wired hinges and pivots at doors requiring power transfer or door monitoring from jamb to door. All electrified hinges and pivots shall be rated for the in-rush amperage of the door mounted device being electrified. .Provide each electrified hinge with leads and harnesses of a type and length sized to properly tie to and operate the door mounted electro-mechanical locking devices.
- I. Fasteners: Package all hinges and pivots with machine and wood screws as required by door and frame construction.

2.3 LOCKS AND LATCHES

- A. Bored Lock and Latch Sets: Extra heavy duty, commercial, cylindrical bodies complying with BHMA A156.2 Series 4000, Grade 1. Furnish cylindrical type, field reversible, lock and latch sets with deadlocking brass or stainless steel latch bolts having a minimum 1/2 inch (13 mm) throw together with guard (auxiliary) latch added to bolt, 2-3/4 inches (70 mm) backset, and UL listed for 3 hour single doors. Furnish latch bolts having a minimum 3/4 inch (19 mm) throw together with guard (auxiliary) latch added to bolt, and UL listed for labeled pairs of fire doors. All lock and latch sets, to be furnished complete with heavy gage steel zinc dichromate coated cylindrical bodies, trim, 2-1/4 inches (57 mm) by 1-1/8 inches (28.6 mm) beveled square cornered fronts, and 6 pin tumbler key in lever core. Provide wrought steel, aluminum, or black plastic, box strikes for each lock and latch set with curved lips of sufficient length to protect frames. Provide plated cast zinc levers with plated wrought brass or bronze roses. Where electro-mechanical locksets are scheduled provide transformers properly sized for conversion of power supply to the power characteristics of the electromechanical locksets. Where electro-mechanical locksets are scheduled provide request to exit (REX) monitoring feature.
1. Sargent 10X Line, **LL Design**; Sargent Manufacturing Company (SGT). Where electro-mechanical locksets are scheduled provide 10G70 Series with trim matching mechanical locksets.
 2. Corbin-Russwin CLX3300 Series, **Newport NZD Design**; Corbin Russwin Architectural Hardware (CR). Where electro-mechanical locksets are scheduled provide CL33900 Series with trim matching mechanical locksets.
 3. Schlage ND-Series, **Rhodes RHO**; Schlage Lock Company (SCH). Where electro-mechanical locksets are scheduled provide ND Series Electrified Locks with trim matching mechanical locksets.
 4. Best 93K Series, **15C**; Best division of Dormakaba (BE). Where electro-mechanical locksets are scheduled provide DEL function with trim matching mechanical locksets.
- B. Mortise Lock and Latch Sets: Heavy duty, commercial, mortise bodies complying with BHMA A156.13 Series 1000, Grade 1, with throughbolted lever trim. Furnish mortise type, field reversible without disassembly, field multifunctional without opening lock cases, lock and latch sets with 1 or 2 piece anti-friction deadlocking stainless steel latchbolts having a minimum 3/4 inch (19 mm) throw, 2-3/4 inches (70 mm) backset, and UL listed for 3 hour doors. All lock and latch sets, to be furnished complete with heavy 0.109 inch (2.77 mm) (12 gage) wrought steel zinc dichromate or chrome plated case, trim, adjustable beveled square cornered armored fronts, cold forged steel or stainless steel hubs, and 6 pin cylinders. Conceal fastenings, washers and bushings. Provide wrought, or black plastic, box strikes for each lock and latch set. Provide brass, bronze or stainless steel strikes with curved lips of sufficient length to protect frames. Provide solid forged or cast levers with wrought roses. Where electro-mechanical locksets are scheduled provide transformers properly sized for conversion of power supply to the power characteristics of the electromechanical locksets. Where electro-mechanical locksets are scheduled provide request to exit (REX) monitoring feature.

1. Sargent 8200 Series, **LNJ Design** x 130 KB Turnlever; Sargent Manufacturing Company (SGT). Provide handed ANSI 4-7/8" curved lip strikes die punched to match bolts provided with latchset functions only, provide non-handed standard curve lip strikes 82-0110 for all other functions. Where electro-mechanical locksets are scheduled provide 8270 Series with trim matching mechanical locksets.
 2. Corbin-Russwin ML2000 Series, **Lustra LSA Design** x 519F10 Thumbturn Lever; Corbin Russwin Architectural Hardware (CR). Provide handed ANSI 4-7/8 inches curved lip strikes die punched to match bolts provided with latchset functions only 340L62 (RH) and 340L63 (LH), provide handed standard curve lip strikes for all other functions 340L60 (RH) and 340L61 (LH). Where electro-mechanical locksets are scheduled provide ML20900 ECL Series with trim matching mechanical locksets.
 3. Schlage L9000 Series, **03 Design x A Rose x 09-509 Turnlever**; Schlage Lock Company (SCH). Provide handed ANSI 4-7/8 inches curved lip strikes die punched to match bolts provided with latchset functions only (Part No. XL11-820/XL11-821), provide non-handed standard curve lip strikes for all other functions 10-072. Where electro-mechanical locksets are scheduled provide L9090EL Series with trim matching mechanical locksets.
 4. Best 45H Series, with **3 Lever Design x H Rose x Thumbturn**; Best division of Dormakaba (BE). Provide handed ANSI 4-7/8" curved lip strikes die punched to match bolts provided with latchset functions only S5, provide handed standard curve lip strikes for all other functions S6. Where electro-mechanical locksets are scheduled provide 45HW Series with trim matching mechanical locksets.
- C. Bottom Rail Mortised Deadlocks: Heavy duty, commercial, deadlock complying with BHMA A156.5 Type E8211, Grade 1. Furnish bottom rail deadlocks less thumb turn and key cylinders. Where thumb turn, or key, cylinders are scheduled, furnish types as specified for mortise locks fitted with proper cams.
1. MS1861; Adams-Rite Manufacturing Co. (ARM).
- D. Push-Button Combination Locks:
1. Bored Lock Set Combination Locks:
 - a. KP10G77; Sargent Manufacturing Company (SGT).
 - b. CO-100-CY Series Locks; Schlage Lock Company (SCH).
 - c. L1000 Series; Kaba Ilco Corp.
 - d. E-Plex 2000 Bored Lock Series; Best division of Dormakaba (BE)
 2. Mortise Lock Set Combination Locks:
 - a. KP8200; Sargent Manufacturing Company (SGT).
 - b. CO-100-MS Series Locks; Schlage Lock Company (SCH).
 - c. 8100 Series; Kaba Ilco Corp.
 - d. E-Plex 2000 Mortised Lock Series; Best division of Dormakaba (BE)
- E. Rabbeted Doors: Provide special rabbeted front and strike on locksets for rabbeted meeting stiles.

2.4 ELECTROMAGNETIC LOCKS

- A. Exposed, Surface Applied Type: Surface mount application with a minimum 1500 pound (675 kg) holding force at 24 V, provide complete with all cabling, rectifier kits, holding force sensors, adjustable time delay, and mounting hardware, complying with BHMA A156.23, Grade 1, high security, fail-safe operation.
1. M490P; Schlage Electronics (SCH).
 2. 1511 EmLock; Security Door Controls (SDC).
 3. Magnalock M82BD Series; Securitron (SEC).
- B. Concealed, Shear Type: Top mount application with a minimum 1000 pounds (450 kg) holding force at 24 V, vertical armature adjustment thru edge of door, provide complete with all cabling, rectifier kits, holding force sensor, and mounting hardware, complying with BHMA A156.23, Grade 2, medium security, fail-safe operation.
1. GF3000TRD; Schlage Electronics (SCH).
 2. 1562-HTR Hi/Shear EmLock; Security Door Controls (SDC).
 3. Shear Aligning Magnalock (SAM); Securitron (SEC).
- C. Exposed, Delayed Egress Type: Surface mount application with a minimum 1200 pound (540 kg) holding force at 24 V dc, and audible signal, provide with magnetic bond sensor, door status monitoring, anti-tamper switch, security alarm, set for 15 or 30 second delay as permitted by Code, provide complete with all cabling, rectifier kits, and mounting hardware, complying with BHMA A156.23, Grade 2, medium security, fail-safe operation. Provide custom length housing at paired openings.
1. M490DE Delayed Egress Series; Schlage Electronics (SCH).
 2. 1511S/T Series Delayed Egress Locks; Security Door Controls (SDC).
 3. DEM680E; Securitron (SEC).

2.5 DOOR BOLTS

- A. Manual Surface Bolts: Provide 12 inch (304.8 mm) surface mounted slide bolts UL Listed for A labeled metal fire doors and complying with BHMA A156.16, Type 84161. Furnish manufacturer's standard guide brackets and strikes for conditions indicated.
1. 1012F; Door Controls International (DCI).
 2. SB453-12; Ives (IVS).
 3. 580-12; Rockwood Manufacturing Company (RM).

- B. Manual Flush Bolts: Provide flush bolts, with 1 inch (25.4 mm) wide fronts, in paired sets (top and bottom), with 1/2 inch (12.7 mm) diameter flattened bolt tip for both wood and metal doors and standard 12 inch (304.8 mm) rod at flushbolts for metal doors. Flush bolts shall fit ANSI A115.4 door and frame preparation. Bolts to comply with BHMA A156.16, Type L14081, L14251, L04261 or L24081. Furnish rods of proper length to afford easy reach from the floor. Furnish manufacturer's standard top strikes for top bolts.
1. Manual Flushbolts for Wood Doors: One of the following:
 - a. No. 790F; Door Controls International (DCI).
 - b. FB358; Ives (IVS).
 - c. 3913; Trimco Hardware (TBM).
 - d. 557; Rockwood Manufacturing Company (RM).
 2. Manual Flushbolts for Metal Doors: One of the following:
 - a. No. 780F; Door Controls International (DCI).
 - b. FB458; Ives (IVS).
 - c. 3917; Trimco Hardware (TBM).
 - d. 555; Rockwood Manufacturing Company (RM).
- C. Self-Latching Flush Bolt Assemblies for Metal Fire Doors: BHMA A156.3, Type 27; one of the following:
1. No. 845 (805 top bolt x 840 automatic bottom bolt); Door Controls International (DCI).
 2. FB51P (FB51T constant latching top bolt x FB31B automatic bottom bolt; Ives (IVS).
 3. 3820 (3820 x 3810); Trimco Hardware (TBM).
 4. 2845 automatic flush bolt x constant self-latching top bolt; Rockwood Manufacturing Company (RM).
- D. Self-Latching Flush Bolt Assemblies for Wood Fire Doors: BHMA A156.3, Type 27; one of the following:
1. No. 945 (905 top bolt x 940 automatic bottom bolt); Door Controls International (DCI).
 2. FB41P (FB41T constant latching top bolt x FB41B automatic bottom bolt; Ives (IVS).
 3. 3825L (3825L x 3815L); Trimco Hardware (TBM).
 4. 2945 automatic flush bolt x constant self-latching top bolt; Rockwood Manufacturing Company (RM).

2.6 EXIT DEVICES

- A. Exit Devices: Exit devices and exit device accessories shall conform to BHMA A156.3, Grade 1. Trim shall be wrought construction and commercial plain design with straight, beveled or smoothly rounded sides, corners and edges. Keyed devices shall be furnished less cylinders. Cylinders shall be as herein specified keyed to building system.
- B. Push Bar Style Exit Devices: One of the following:
 - 1. 9400 Series (for narrow stile doors), function and trim as scheduled; Sargent Manufacturing Company (SGT).
 - 2. 55 Series (for narrow stile doors), function and trim as scheduled; Von Duprin (VD).
- C. Push Pad Style Exit Devices: One of the following:
 - 1. 80 Series, function and trim as scheduled; Sargent Manufacturing Company (SGT).
 - 2. 99 Series, function and trim as scheduled; Von Duprin (VD).
 - 3. Advantex Series, function and trim as scheduled; Detex (DET).
 - 4. Apex 2000 Series, function and trim as scheduled; Precision (PHI).
- D. Low Profile "Recessed" Push Pad Exit Devices: 9447 InPact; Von Duprin.
- E. Ornamental Exit Devices and Exterior Pulls for Interior Doors: UL 305 listed devices that have been panic load tested for use on all-glass entrance doors, and comply with ANSI/BHMA A156.3, Grade 1 or ANSI/BHMA A156.44. Provide glass door panic devices fabricated principally from 1-1/4 inch (32 mm) diameter satin finished stainless steel tubing. Operation: The top latch bolt of the panic device shall be retracted by pushing the interior "L" shaped crash bar. In addition a built-in dogging device shall be provided which keeps the latch bolt in the retracted position and the crash bar becomes fixed. An exterior key cylinder for entry shall also be provided with each device.
 - 1. PA100F Panic Device x Full Height F-Handle on Exterior; Blumcraft Div. of C. R. Laurence.
 - 2. PDU8000-3 Glass Door Panic Device with Full Height Straight Pull on Exterior: Rockwood.
 - 3. GP1000 Series with Top Latching Bolt and Full Height Straight Pull on Exterior; Dorma Kaba.
- F. 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.
- G. Fire Exit 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.

- H. Outside Trim: Match design for locksets and latchsets, unless otherwise indicated.

2.7 CYLINDERS AND KEYING

- A. Cores for Bored Cylindrical Locksets: Provide key-in lever 6 pin cores for all bored cylindrical locksets, keyed into base building system, as manufactured by the bored lockset manufacturer.
- B. Cylinders: Full faced cylinders with square shouldered (not tapered) compression rings, 6 pin cylinders, standard threaded, keyed into building system, with cams to suit lock functions. Provide cylinders for installation into all locks.
1. 1100 Series Flexible Head Mortise Cylinder; Corbin Russwin Architectural Hardware (CR).
 2. Series 40 Adjustable Front Cylinder; Sargent Manufacturing Company (SGT).
 3. 30-001 full-faced mortised cylinder with 36-083 compression rings; Schlage Lock Company (SCH).
 4. 1E Series with Straight Rings; Best division of Dormakaba (BE).
- C. Keying System: Final keying to determine lock cylinders, keyed alike sets, level of keying, master key groups, grandmaster keying system shall be as directed by the Owner. Supplier and Contractor shall meet with the Owner and obtain final instructions in writing. Provide two nickel silver keys for each lock, and six keys for each grandmaster and masterkey system. Provide two blank keys for each lock for the Owner's convenience in making additional keys.
1. Temporary Cylinders: Provide temporary cylinders in locks during construction and as may be necessary for security or as may be requested by the Owner. All temporary cylinders shall be individually keyed as required and subject to a single master key.
- D. Key Control System: Furnish a key control system with complete accessories including key gathering envelopes, labels, reserve pattern key tags with self-locking key clips, key receipt forms, key receipt holders, 3-way visible card index, temporary key markers and permanent key markers.

2.8 STRIKES

- A. Strikes for Locks and Latches: All strikes for locks and latches shall be provided by the lock and latch manufacturer unless otherwise specified or scheduled, refer to Article 'Locks and Latches.'
- B. Dustproof Floor Strikes: Complying with BHMA A156.16, Type L04251, L04021 or L14021, one of the following:
1. No. 80; Door Controls International.
 2. DP2; Ives.
 3. 3910; Trimco Hardware (TBM).

4. 570; Rockwood Manufacturing Company (RM).

C. Electric Strikes: Complying with BHMA A156.31, Grade 1. Mortised type for devices mounted in hollow metal frames. Unless otherwise required to interphase with the security access system furnish in 24 volt DC continuous voltage for silent operation. Provide each strike with extended lips as required to suit jamb conditions and fail secure function. Remote electrical control from card reader or control panel will unlock strike jaw, releasing latchbolt of the deadlatch, so door can be opened without operating latch by key cylinders from outside of secured room. Electric strikes shall be UL listed for up to 3 hour fire door assemblies.

1. 6200 Series Electric Strikes; Von Duprin.
2. 1006 Series Electric Strikes; HES.
3. Folger Adam 310-1 (FA3101-24VDC) with 3/4 inch (19 mm) straight latch bolt keeper; HES.

2.9 OPERATING TRIM (PUSHES AND PULLS)

A. Type 1: Fabricate push pulls for back to back mounting from 1-1/2 inch (38-mm) diameter stainless steel bar stock in finish as scheduled. Custom fabricate push pulls to length indicated with minimum 2-11/16 inch (68-mm) projection, minimum 1-1/2 inch (38-mm) clearance with bases centered and anchored to top and bottom rails. Furnish spacers threaded to accept concealed throughbolt attachment including provision for spanner tightening of bolts of assembly. Do not provide baseplates at stile to pull interface.

1. T51-01-023; Elmes.

B. Type 2: Fabricate push pulls for back to back mounting from 1-inch (25-mm) diameter stainless steel bar stock in finish as scheduled. Custom fabricate pulls with minimum 3-1/4 inch (83-mm) projection, 2-1/4-inch (57-mm) clearance, minimum 4-inch (102-mm) offset, 10-inch (245-mm) center to center of bases with center line of pull centered on door stiles. Furnish spanner turning washer and stud assemblies threaded to accept concealed throughbolt attachment including provision for spanner tightening of bolts of push/pull assembly. Do not provide baseplates at stile to pull interface. Provide one of the following:

1. 1191-3; Trimco Hardware (TBM).
2. BF157; Rockwood Manufacturing Company (RM).

C. Type 3: Fabricate push pulls for back to back mounting from 1 inch (25 mm) diameter stainless steel bar or tube stock in finish as scheduled. Custom fabricate push pulls to length indicated with minimum 3-inch (76-mm) projection, minimum 2 inch (51 mm) clearance with bases centered on door stiles and anchored to top and bottom rails. Furnish spacers threaded to accept concealed throughbolt attachment including provision for spanner tightening of bolts of assembly. Do not provide baseplates at stile to pull interface.

1. RM3300 with straight intermediate post; Rockwood Manufacturing Company (RM).
- D. Type 4: Full mortised, cast bronze or brass flush door pull, with black painted interior, complying with BHMA A156.6, Type J403 except with concealed fastening, and having minimum overall dimensions of 2-1/2 inch (63.5 mm) by 4 inches (102 mm).
1. 1060; Trimco Hardware (TBM).
 2. 61064 Flush Pull; Tydix (TY).
 3. Flush Pull 95B; Rockwood Manufacturing Company (RM).
 4. 17N; Hager Companies (HAG).
- E. Type 5: Full mortised, solid, bronze or brass door edge pull, with 1/2 inch (13 mm) finger clearance, having nominal overall dimensions of 4 inches (102 mm) long by 2.56 inches (65 mm) overall, with minimum 11/16 inch (17.5 mm) backbend drilled and countersunk to receive a minimum of two screw fasteners; form for full mortise application with lock edge face shaped for square or bevel cut edge as indicated; finish as scheduled.
1. SRO Style Edge Pull; Tydix (TY).
 2. DP3/DR; Doug Mockett and Co., Inc.
 3. RM754; Rockwood Manufacturing Company (RM).
- F. Type 6: Full mortised, cast brass edge pull, complying with BHMA A156.14, Type D2801, minimum overall dimensions of 3/4 inch by 3-7/8 inch (19 mm by 98 mm).
1. 230; Ives (IVS).
 2. 880 Cast Lever Edge Pull; Rockwood Manufacturing Company (RM).
 3. 9882; Hager Companies (HAG).
 4. 1063; Trimco Hardware (TBM).

2.10 ACCESSORIES FOR PAIRS OF DOORS

- A. Tubular Coordinators and Filler Bars: UL listed for use on labeled doors and complying with BHMA A156.3, Type 21A. Provide with filler piece of length as required to close the header area and mounting brackets at stop mounted hardware. Furnish extenders at active leaf levers where required to clear overlapping astragals on doors installed with pocket pivot hinges or jambs with deep jamb stops.
1. No. 600 Series x Filler Bar; Door Controls International (DCI).
 2. COR Series Coordinators x FL filler; Ives (IVS).
 3. 2600 Series x Filler Bar; Rockwood Manufacturing Company (RM).
- B. Gravity Coordinators: UL listed for use on labeled doors and complying with BHMA A156.3, Type 21B. Minimum 7-inch (178-mm) projection.
1. No. 500 Coordinator; Door Controls International (DCI).
 2. CORG7; Ives (IVS).
 3. 576; Rockwood Manufacturing Company (RM).

- C. Carry Open Bars: UL listed for use on labeled doors and complying with BHMA A156.3, Type 21. Provide carry-open bars for inactive leaves of pairs of doors, unless automatic or self-latching bolts are used.
 - 1. No. CB Carry Bar; Door Controls International (DCI).
 - 2. CB1 Carry Bar; Ives (IVS).
 - 3. 1100; Rockwood Manufacturing Company (RM).
- D. Astragals: UL listed for use on labeled doors, surface applied continuous extruded aluminum minimum 7/8 inch wide retaining EPDM gaskets for installation on both sides of all meeting stiles of doors:
 - 1. 125NA; National Guard Products, Inc. (NGP).
 - 2. 305CN; Pemko Manufacturing Co., Inc. (PEM).
- E. Lock Protectors: Fabricated from heavy gauge metal and in finish as scheduled. Furnish protectors sized to cover the latch bolt area of the door and lock and narrow enough to clear rose and escutcheon lock trims, offset formed to clear strike projection. Machine lock protectors where required to accommodate rose and escutcheon trims, and cylinders.
 - 1. LG Series Lock Guards; Ives (IVS).
 - 2. Latch Guard 320; Rockwood Manufacturing Company (RM).

2.11 CLOSERS

- A. Surface-Mounted Closers with Track Arms: Closers shall be certified by ETL laboratories and the manufacturer to a minimum of 8,000,000 cycles and meet BHMA A156.4, Grade 1. Closers used in conjunction with overhead stops and holders shall be templated and coordinated to function properly. Properly detail closers to meet application requirements by providing drop plates, brackets, etc. to meet application and installation requirements as indicated. Comply with manufacturer's recommendations for size of door closer depending on size of door, stack pressure conditions, exposure to weather, and anticipated frequency of use. Closers shall be non-handed, have adjustable spring power, full rack and pinion, independent closing speed and latch regulating V-slotted valves, all-weather fluid, fully hydraulic with a high strength cast iron cylinder and solid forged steel arms, bore diameter of 1-1/2 inches (38.1 mm), pinion shaft diameter of 5/8 inches (15.87 mm), adjustable back check, cushion and built-in stop feature where scheduled, hold open arms where scheduled, delayed action where scheduled, arm finish to match closer cover finish scheduled. Provide metal covers of clean line design with plated or primed for paint finish as scheduled and that require removal in order to make adjustments to closer.
 - 1. 4040XPT; LCN Closers (LCN).
 - 2. 281 with Track Arm; Sargent Manufacturing Company (SGT).
 - 3. 9500-M-ST; Norton (NO).

- B. Surface-Mounted Closers Without Track Arms : Closers shall be certified by ETL laboratories and the manufacturer to a minimum of 8,000,000 cycles and meet BHMA A156.4, Grade 1. Closers used in conjunction with overhead stops and holders shall be templated and coordinated to function properly. Properly detail closers to meet application requirements by providing drop plates, brackets, etc. to meet application and installation requirements as indicated. Comply with manufacturer's recommendations for size of door closer depending on size of door, stack pressure conditions, and anticipated frequency of use. Closers shall be non-handed, have adjustable spring power, full rack and pinion, independent closing speed and latch regulating V-slotted valves, all-weather fluid, fully hydraulic with a high strength cast iron cylinder and solid forged steel arms, bore diameter of 1-1/2 inches (38.1 mm), pinion shaft diameter of 5/8 inches (15.87 mm), adjustable back check, cushion and built-in stop feature where scheduled, hold open arms where scheduled, delayed action where scheduled, arm finish to match closer cover finish scheduled. Provide metal covers of clean line design with plated or primed for paint finish as scheduled and that require removal in order to make adjustments to closer.
1. 4040XP; LCN Closers (LCN).
 2. 281; Sargent Manufacturing Company (SGT).
 3. PR-9500-M/R-9500-M; Norton (NO).
- C. Overhead Concealed Closers, Butt and Offset Hung: Closers shall meet BHMA A156.4, Grade 1. Properly detail closers to meet application and installation requirements as indicated. Comply with manufacturer's recommendations for size of door closer depending on size of door, stack pressure conditions, and anticipated frequency of use. Provide manufacturer's standard cover plate finished to match exposed portions of butts or pivots provided.
1. 2010/2030; LCN Closers (LCN).
 2. RTS 88 Series, Offset Slide Arm; Dorma.
 3. PH 91 Series; Norton Rixson (RIX).
- D. Overhead Concealed Closers, Center Hung: Closers shall meet BHMA A156.4, Grade 1. Properly detail closers to meet application and installation requirements as indicated. Comply with manufacturer's recommendations for size of door closer depending on size of door, stack pressure conditions, and anticipated frequency of use. Provide manufacturer's standard cover plate finished to match exposed portions of pivots provided. Provide with manufacturer's standard top arm and pivot to suit conditions indicated.
1. 6030; LCN Closers (LCN).
 2. RTS 88 Series, End Loaded Arm; Dorma.

- E. Electromagnetic Overhead Surface Closers: Closers shall meet BHMA A156.15 and NFPA 101. Properly detail closers to meet application requirements by providing drop plates, brackets, etc. to meet application and installation requirements as indicated. Comply with manufacturer's recommendations for size of door closer depending on size of door, stack pressure conditions, and anticipated frequency of use. Arm and track finish to match closer cover finish scheduled. Provide metal covers of clean line design with plated or primed for paint finish as scheduled and that require removal in order to make adjustments to closer. Furnish closers for 24 V AC/DC voltage.

1. Sentronic 4040SE; LCN Closers (LCN).

- F. Floor Closers: Closer sizes shall be as recommended by the manufacturer for size of door, stack pressure conditions, and anticipated frequency of use with special details as follows:

1. Special Details:

- a. Closer Cover Pan: Where stone or ceramic tile flooring is indicated at door thresholds and a special dress plate is not indicated or scheduled, furnish metal pan specially constructed and designed to be installed below and to support removable sections of finished flooring.
- b. Extended Spindles: Furnish extended spindles.
- c. All floor closers shall be manufactured with separate independent valves for closing adjustment, latching adjustment, and backchecking adjustment.
- d. All floor closers shall be provided with a built-in positive deadstop to prevent doors from swinging beyond the desired opening degree.

2. Center Hung, Single Acting, Heavy Duty: 28 Series; with special machined fully concealed arm, non-hold open (NHO), Checkmate No. 1 holders, physically handicapped (PH), delayed action (DA), as scheduled; Norton Rixson (RIX).
3. Offset Hung Heavy Duty: 27 Series; non-hold open (NHO), Checkmate No. 1 holders, physically handicapped (PH), delayed action (DA), as scheduled; Norton Rixson (RIX).
4. Center Hung, Double Acting, Heavy Duty: 40 Series; with special machined fully concealed arm, non-hold open (NHO), physically handicapped (PH), delayed action (DA), as scheduled; Norton Rixson (RIX).
5. Maximum Opening Force:
 - a. Interior Doors: 5 lbf (22.2 N).

2.12 AUTOMATIC DOOR OPERATORS

- A. Overhead Exposed Type Automatic Door Operators: Provide low energy operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for compliance with UL 325. Coordinate operator mechanisms with door operation, pivots, hinges, and activation devices.

1. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.
 2. Standard: Conforming to ANSI/BHMA A156.19.(Power Assist and Low Energy Power Operated Doors) and the ADA.
 3. Operation: Actuation shall be automatic from the specified push buttons and motion detectors. Power opening and spring closing operation shall meet ANSI/BHMA A156.19 (Power Assist and Low Energy Power Operated Doors) and the ADA. Provide time delay for door to remain open before initiating closing cycle as required by ANSI/BHMA A156.19. When not in automatic mode, door operator to function as manual door closer with fully adjustable opening and closing forces, with or without electrical power.
 4. Features: Operator units to have full feature adjustments for door opening and closing force and speed, backcheck, motor assist acceleration from 0 to 30 seconds, time delay, vestibule interface delay, obstruction recycle, and hold open time from 0 up to 30 seconds.
 5. Provide outputs and relays on board the operator to allow for coordination of exit device latch retraction, mortised lock latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors, security contractor provided devices, and specified auxiliary contacts as indicated. Input power preparations shall be coordinated with electrical work.
 - a. Security devices will be provided by the Owners security contractor.
 6. Brackets and Reinforcements: Manufacturer's standard, fabricated from aluminum with nonferrous shims for aligning system components.
- B. Overhead Exposed Type Automatic Door Operators Products and Manufacturers: One of the following:
1. 4100 LE Heavy Duty Low Energy Door Operator; Horton Automatics Div. of Overhead Door Corp.
 2. Entrematic DITEC HA8 Series; Record USA Inc.4630/4640; LCN Closers, an Allegion PLC Company.
 3. ED900 Series; Dorma.
 4. SW200i Series; Besam.

2.13 PROTECTIVE TRIM UNITS

- A. Kick and Armor Plates: Fabricate protection plates from minimum 0.050 inch (1.3 mm) thick stainless steel, beveled top and 2 sides (B3E), square corners, complying with BHMA A156.6, and fastened with oval head Phillips fasteners countersunk into plate surface.
1. Series 8400; Ives (IVS).

2. K1050 Doorplate Series; Rockwood Manufacturing Company (RM).
3. KA050-2 Armor Plate and KOO50 for Kickplates; Trimco Hardware (TBM).

- B. Size: Furnish kick and armor plates sized 2 inches (51 mm) less than door width when located on push side of door and 1 inch (24.5 mm) less than door width when indicated on the pull side of door. Furnish kickplates 12 inches (305 mm) high, furnish armor plates 48 inches (1219 mm) high unless otherwise indicated. Provide protective plates with cutouts for locks, louvers and windows to the extent indicated. Mount protective plates flush with bottom of door.

2.14 STOPS AND HOLDERS

- A. Angle Stops: Special angle stop, fabricated from brass or bronze, for single or pairs of doors without stops and having either a single continuous formed sponge silencer or a minimum of two rubber silencers per stop, minimum 1-1/2 inches (38 mm) wide x 3 inches (76 mm) long base for mortising into the head of door frame, minimum 3/4 inch (19 mm) maximum stop face projection; finish as scheduled.

1. AS18 Angle Stop; Ives (IVS).
2. 489; Rockwood Manufacturing Company, Inc. (RM).
3. 1801 Angle Stop; Architectural Builders Hardware Mfg., Inc. (ABH).

- B. Roller Latch Angle Stops: Special angle stop BHMA A156.16 Type E19111, fabricated from brass or bronze, for single doors without stops and having a minimum of two rubber silencers per stop, minimum 1-1/2 inches (38 mm) wide x 4-1/2 inches (114 mm) long base for mortising into the head of door frame, 9/16 inch (14 mm) maximum stop face projection, adjustable roller latch and ramp roller strike; finish as scheduled.

1. 4040 Adjustable Roller Latch; Door Controls International (DCI).
2. RL1152; Ives (IVS).
3. 593; Rockwood Manufacturing Company (RM).
4. 1559BL; Trimco Hardware (TBM).

- C. Roller Latches: Special roller latch complying with BHMA A156.16 Type E19101, fabricated from brass or bronze, for single doors, minimum 1 inch (25 mm) wide x 3-3/8 inches (86 mm) long base for mortising into the head door frame, adjustable nylon covered roller latch and ramp roller strike; finish as scheduled.

1. 4030 Adjustable Roller Latch; Door Controls International (DCI).
2. RL30; Ives (IVS).
3. 590; Rockwood Manufacturing Company (RM).
4. 1559WA; Trimco Hardware (TBM).

- D. Ball Type Latches: 4-way adjustable ball catch complying with BHMA A156.9 Type B13292, fabricated from brass or bronze, for single doors, with two adjustable stainless steel balls held under adjustable spring tension and hook strike.

1. CL21A; Ives (IVS).

- E. Concealed Overhead Door Holders: Heavy duty, concealed mounting, full mortised, bronze bodied, slide track design, with heavy shock absorber spring providing 5 to 7 degree compression before deadstop, non-metal slide and shock blocks, 110 degree maximum opening, complying with BHMA A156.8 Type C11511 for hold open and Type C11541 for stop function. Provide stop, or hold open, functions as scheduled.
1. 1000 Series; Architectural Builders Hardware Mfg., Inc. (ABH).
 2. 100 Series; Glynn-Johnson (GJ).
 3. Checkmate Heavy Duty 1 Series; Norton Rixson (RIX).
- F. Exposed Overhead Door Holders: Heavy duty, surface mounted, bronze bodied, slide track design, with heavy shock absorber spring providing 5 to 7 degree compression before deadstop, non-metal slide and shock blocks, 110 degree maximum opening, complying with BHMA A156.8 Type C12511 for hold open and Type C12541 for stop function. Provide stop, or hold open, functions as scheduled.
1. 9000 Series; Architectural Builders Hardware Mfg., Inc. (ABH).
 2. 90 Series; Glynn-Johnson (GJ).
 3. Checkmate Heavy Duty 9 Series; Norton Rixson (RIX).
- G. Floor Stops: Cast half dome design with rubber bumper, finish as scheduled. Provide manufacturer's standard riser heights as required for carpeted areas in conjunction with the floor bumpers scheduled. Unless otherwise scheduled, provide floor stops at each door leaf where partition construction does not allow the door to swing greater than 90 degrees.
1. For Thresholds, Carpet and/or Undercut Doors: Comply with BHMA 156.16 Type L12161, L02161 or L12141.
 - a. 3320X; Door Controls International (DCI).
 - b. FS438; Ives (IVS).
 - c. 1211; Trimco Hardware (TBM).
 - d. 443; Rockwood Manufacturing Company (RM).
 2. For Doors with Standard 3/8 inch (9.5 mm) Clearance: Comply with BHMA 156.16 Type L12161, L02141 or L12141.
 - a. 3310X; Door Controls International (DCI).
 - b. FS436; Ives (IVS).
 - c. 1210; Trimco Hardware (TBM).
 - d. 441; Rockwood Manufacturing Company (RM).
 3. For Acoustical Doors: A security type door stop, molded from black flame resistant resilient material wrapped around a heavy duty threaded steel stud for grouting into the floor substrates, approximately 1-1/2 inch (38 mm) tall x 2 inch (50.8 mm) diameter x 2-1/2 inch (63.5 mm) stud length.
 - a. FS18S; Ives.
 - b. 1209; Trimco Hardware (TBM).
 - c. 466; Rockwood Manufacturing Company (RM).

- d. 269F; Hager Companies (HAG).
 - H. Silencers for Metal Door Frames: BHMA A156.16, Type L03011; grey rubber, minimum diameter 1/2 inch (13 mm); fabricated for drilled-in application to frame, specifically designed to form an air pocket to absorb shock and reduce noise of door closing. Provide two silencers for each pair of doors, three silencers for each single door.
 - 1. 8S; Door Controls International (DCI).
 - 2. SR64; Ives (IVS).
 - 3. 1229A; Trimco Hardware (TBM).
 - 4. 608; Rockwood Manufacturing Company (RM).
 - I. Wall Stops: Cast disc type with concave rubber bumper, having a minimum of 2-1/8 inch (54 mm) diameter base with nominal 1 inch (25 mm) projection and concealed attachment to substrate. Unless otherwise scheduled, provide wall stops at each door leaf where partition construction does not allow the door to swing greater than 90 degrees.
 - 1. For Attachment to Masonry: Complying with BHMA A156.16, Type L12251 or L12101.
 - a. WS401CCV; Ives (IVS).
 - b. 1270CV; Trimco Hardware (TBM).
 - c. 404; Rockwood Manufacturing Company (RM).
 - 2. For Attachment to Gypsum Wallboard: Complying with BHMA A156.16, Type L12251 or L12101.
 - a. WS402CCV; Ives (IVS).
 - b. 1270WV; Trimco Hardware (TBM).
 - c. 403; Rockwood Manufacturing Company (RM).
 - J. Magnetic Catches: Aluminum bodied extra heavy duty magnetic catch with outside dimensions of approximately 13/16 x 3-1/8 x 1 inch (20.63 x 79.37 x 25 mm) complying with BHMA A156.9, Type B03161 fabricated with self aligning magnets and furnished complete with door strikes.
 - 1. 327; Ives (IVS).
 - 2. 901; Rockwood Manufacturing Company (RM).
 - 3. CD45 Double Magnetic Cabinet Catch; Stanley Commercial Hardware (STH) division of Dorma/Kaba.
- 2.15 SLIDING DOOR HARDWARE
- A. Sliding Door Hardware: Provide complete sets consisting of continuous ball bearing hanger tracks, door hangers with provision for horizontal and vertical adjustments, floor guide, supports, track mounted stops, and rated for a door weight of 1000 pounds (454 kg).

1. Top Line Grant 5300; Hettich International.

2.16 MISCELLANEOUS DOOR HARDWARE

- A. Boxed Power Supplies: Provide modular units complying with NEMA ICS 6, electrified for Type 4 enclosure; filtered and regulated; voltage rating and type matching requirements of door hardware served; and listed and labeled for use with fire alarm systems.
- B. Palm Button Release Device: Provide a "request to exit" palm button release device for use with alarm and signaling systems. Button shall be a minimum of 1-5/8 inches (40 mm) in diameter and be mounted to a maximum 1-3/4 inch (44 mm) wide by 4-1/2 inches (114 mm) high brushed stainless steel mounting plate designed to mount into metal door frames as narrow as 1-3/4 inches (44 mm). Provide each mushroom head red button with 24 volt indicator lamp. Provide each button with an engraved white plastic laminate sign to be applied adjacent to the button instructing the user as to the operation and function of the button.
 1. 623RD-EX; Schlage Electronics (SCH).
 2. 430N-R-U-LED; Security Door Controls (SDC).
- C. Mortised Power Transfer Devices: Heavy duty, tamper resistant mortised power transfer devices with ten wires, complying with requirements of UL10C for fire-rated doors. Provide one of the following:
 1. CEPT-10; Securitron (SEC).
 2. EPT-10; Von Duprin (VD).
 3. PTM-10; Security Door Controls (SDC).
- D. Passive Infrared Detector: A detector specifically designed for request to exit applications. Each detector shall be provided with a high impact white ABS plastic enclosure, be set for fail safe mode, and be fabricated for an operating temperature of 20 to 120 deg F (-29 to 49 deg C). Latch relay time shall be adjustable for up to 30 seconds.
 1. Scan II - W; Schlage Electronics (SCH).
 2. MD-31DOW; Security Door Controls (SDC).
 3. XMS Motion Detector; Securitron (SEC).
- E. Coat Hooks: Double coat hook, cast brass bodied, minimum 1-1/8 by 1-1/8 by 1-1/8 inch (28.6 by 28.6 by 28.6 mm) projection.
 1. 582 Double Coat Hook; Ives (IVS).
 2. Small Double Coat Hook No. 796; Rockwood Manufacturing Company (RM).

- F. Wrap Around Plates: Fabricate wrap around plates from 22 gauge stainless steel, a 1-3/4 inch (45 mm) door thickness, an 8 by 1-1/4 inch (200 by 32 mm) recess on lock edge for ANSI Type 86 mortise locks, and outside face dimensions of not less than 5 by 12 inch (128 by 300 mm) for rim locks and mortised locks, provide each wrap around with sheet metal screws for securing the wrap around to the door faces through factory punched holes in the corners of the wrap around outside faces. The wrap around shall be either field or factory drilled to templates to receive spindles, cylinders.
1. Wrap around plate with cut outs for specified rim device; Don-Jo Mfg., Inc.
 2. Mortised lock wrap around plate for 86 cut out 504-CW; Don-Jo Mfg., Inc.

2.17 FABRICATION

- A. Manufacturer's Nameplate: Provide each door hardware item without exposed manufacturer's labels, names, or designs.
- B. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended. Provide Phillips oval-head screws with finished heads to match surface of door hardware item being attached. Machine screws and expansion shields shall be used for attaching hardware to concrete and masonry. Use throughbolts for renovation work only where existing door blocking and reinforcements are unknown.
1. Concealed Fasteners: All new doors and door frames have been specified with adequate blocking and reinforcement provisions to eliminate exposed throughbolting of hardware items. Doors installed with exposed throughbolts will be rejected and replaced by the Contractor at no cost to the Owner. Where through bolts are used on existing doors provide sleeves for each through bolt.

2.18 FINISHES

- A. Standard: Comply with BHMA A156.18.
- B. Appearance of Finished Work: Finishes of the same designation, that come from two or more sources, shall match when the items are viewed at arm's length and approximately 24 inches (610 mm) apart. Unless otherwise scheduled, match each hardware item in a single hardware set with the scheduled latch or lock set finish. Painting of BHMA 600 (USP) surfaces is required and is specified under Section 099123 "Interior Painting."
- C. Designations: The abbreviations used to schedule hardware finishes are generally BHMA (Federal Standards where indicated in parenthesis) designations. Comply with base material and finish requirements indicated by the following:
1. BHMA 600 (USP): Primed for painting.
 2. BHMA 605 (US3): Bright brass, clear coated.
 3. BHMA 606 (US4): Satin brass, clear coated.
 4. BHMA 611 (US9): Bright bronze, clear coated.

5. BHMA 612 (US10): Satin bronze, clear coated.
6. BHMA 613 (US10B): Dark-oxidized satin bronze, oil rubbed.
7. BHMA 618 (US14): Bright nickel plated, clear coated.
8. BHMA 619 (US15): Satin nickel plated, clear coated.
9. BHMA 622:(US19): Flat black coated.
10. BHMA 625 (US26): Bright chromium plated.
11. BHMA 626 (US26D): Satin chromium plated.
12. BHMA 628 (US28): Satin aluminum, clear anodized.
13. BHMA 629 (US32): Bright stainless steel.
14. BHMA 630 (US32D): Satin stainless steel.
15. Alum.: Aluminum.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Hardware for fire door assemblies shall be installed in accordance with NFPA 80. Hardware for smoke and draft control door assemblies shall be installed in accordance with NFPA 105. Install hardware for non-labeled and non-smoke and draft door assemblies in accordance with BHMA A156.115 for steel doors and frames, BHMA A156.115-W series for wood doors, and hardware manufacturer's installation instructions for doors and frames fabricated from other than steel or wood.
 1. All modifications to fire doors and frame for electric and mortised hardware shall be made by the respective door and frame manufacturers.
- B. Smoke Seals at S Labeled Door Assemblies: Provide and install smoke seals at S labeled doors in accordance with door manufacturer's instructions.

3.2 INSTALLATION

- A. Mounting Heights: Mount door hardware units at the following heights, unless specifically indicated on the Drawings or required to comply with governing regulations:
 1. Locks and Latches: 38 inches (956 mm) to center of lever from finish floor.
 2. Door Pulls: 44 inches (1118 mm) from finish floor to center of grip. Pull bases centered on door stiles, unless otherwise indicated.
 3. Door Pulls: Pull bases centered on top and bottom door rails, and spaced from lock edge of door stile as indicated, or recommended, by the pull manufacturer.
 4. Push Plates: 44 inches (1118 mm) from finish floor to center of plate. Coordinate with pull location.
 5. Horizontal Push/Pull Bar: 42 inches (1067 mm) from finish floor to center of pull/pull. Push/Pull bases centered on door stiles, unless otherwise indicated.
 6. Butt Hinges: 10 inches (254 mm) to bottom of lowest hinge from finish floor; 5 inches (127 mm) to top of upper hinge from top of door; space intermediate hinges equally between lower and upper hinges.

7. Deadbolts: Not more than 44 inches (1118 mm) from finish floor to operating trim.
 8. Flush Bolt Operating Mechanisms: Top bolt 66 to 72 inches (1676 to 1829 mm) from finish floor, bottom bolt 12 inches (305 mm) from finish floor.
 9. Exit Devices: 40 inches (1016 mm) from finish floor to center of touch bar. 38 inches (965 mm) from finish floor to center of cross bar.
 10. Coat Hooks: 48 inches (1200 mm) from finish floor to top of coat hook.
- B. Install each door hardware item to comply with manufacturer's written instructions. Install overhead surface closers for maximum degree of opening obtainable. Place on room side of corridor doors, stair side of stair doors, secondary corridor side of doors between corridors. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be finished, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
1. All wall stops shall be installed with reinforced blocking in wallboard construction. Drywall anchors are not an acceptable means of reinforcement/blocking. Provide intermediate steel plates or channel reinforcement backing at wall stops mounted in wallboard construction.
- C. Do not install permanent key cylinders in locks until the time of preliminary acceptance by the Owner. At the time of preliminary acceptance, and in the presence of the Owner's representative, permanent key all lock cylinders. Record and file all keys in the key control system, and turn system over to Owner for sole possession and control.
- D. Key control storage system shall be installed where directed by the Owner.
- 3.3 ADJUSTING
- A. Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every hardware component. Replace hardware components that cannot be adjusted to operate as intended. Adjust door control devices to compensate for building stack pressures, final operation of forced air mechanical equipment and to comply with referenced accessibility requirements.
1. Test each electrical hardware item to determine if devices are properly functioning. Wiring shall be tested for correct voltage, current carrying capacity, and proper grounding. Stray voltages in wiring shall be eliminated.
 2. Coordinate with electrical installation for interface and connection with life safety and security systems.

- B. Fire-Rated Door Assembly Testing: Upon completion of the installation, test each fire door assembly in the project to confirm proper operation of its closing device and that it meets all criteria of a fire door assembly as per NFPA 80. The inspection of the fire doors is to be performed by individuals with knowledge and understanding of the operational components of the type of door being subjected to testing and who are either credentialed as an Architectural Hardware Consultant (AHC), an Door and Hardware Consultant (DHC), or as a Certified Fire and Egress Door Assembly Inspector (CFDAI). A written record shall be maintained and transmitted to the Owner to be made available to the Authority Having Jurisdiction (AHJ). The record shall list each fire door assembly throughout the project, and include each door number, an itemized list of hardware set components at each door opening, and each door location in the facility.

3.4 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation. Clean hardware components as necessary to restore proper finish. Provide protection during the progress of the work and maintain conditions that ensure door hardware is in perfect working order and without damage or deterioration at time of Substantial Completion.

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Doors.
 - 2. Glazed entrances.
 - 3. Storefront framing.
- B. Refer to Section 084113 "Aluminum-Framed Entrances and Storefronts" for requirements applicable to single subcontract responsibility for glazing.

1.2 REFERENCES

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: "Glazing Manual" and "Laminated Glass Design Guide."

1.3 ACTION SUBMITTALS

- A. Product Data: Submit product data for each glass product and glazing material indicated.
- B. Sustainable Design Submittals: Refer to Division 01 Section "Sustainable Design Requirements."
- C. Samples: Label samples to indicate product, characteristics, and locations in the Work. Furnish samples of the following:
 - 1. Except for clear glass, submit samples of each glass type specified, in the form of 12 inch (300 mm) square Samples.
 - 2. Submit samples of each glass type specified where production run varies and defects are expected.
 - 3. Submit samples of applied film adhered to clear glass, in the form of 12 inch (300 mm) square samples.

1.4 INFORMATIONAL SUBMITTALS

- A. Embodied Carbon Submittals: Refer to Section 018133 "Sustainable Design Requirements - Embodied Carbon."
- B. Manufacturer Certificates: Submit a letter from glass manufacturer certifying that it has reviewed the glazing details proposed for the Project, including the use of gaskets and sealants, and that each product to be furnished is recommended for the application shown.
- C. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
 - 1. Material Certificates: Submit glass treatment certificates signed by manufacturer of the heat-soaked glass products certifying that products furnished comply with requirements.
 - 2. Quality Control Procedures:
 - a. Submit quality control procedures for minimizing risks of float glass contamination from float glass manufacturer.
 - b. Submit factory logs documenting heat soak testing of all fully tempered glass in accordance with EN-14179-1, including: Calibration log (latest), documentation of temperature profile for each batch (demonstrating dwell time), and number of lites broken during test.
 - c. Submit quality assurance logs of residual compressive surface stress measurements and confirmation of safety glazing performance after heat-soak testing.
- D. Warranties: Submit special warranties specified in this Section.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Submit maintenance data for each applied glass film to be installed or applied, including recommendations and instructions for cleaning, maintenance, removal, and replacement of same.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

C. Safety Glass: Comply with the applicable requirements of the laws, codes, ordinances and regulations of Federal and Municipal authorities having jurisdiction; wherever requirements conflict, the more stringent shall be required. Obtain approvals from all such authorities. As a minimum, provide Category II complying with testing requirements in 16 CFR 1201 (Consumer Product Safety Commission "Safety Standard for Architectural Glazing Materials," as published in the Code of Federal Regulations) and ANSI Z97.1 for Category A performance.

1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction. Locate permanent markings in one corner, and in the same location, of each glass lite in accordance with the requirements of the SGCC labeling guidelines. Markings shall have a nominal size of no greater than 1-inch (25.4-mm) in diameter, and be located with glass edge clearances, at the corner, by not more than 3/4-inch (19-mm) up and 3/4-inch (19-mm) over.
2. For safety glazing and heat treated glass type, Glazing types with multiple lites of glass, laminated unit, provide labels that align in position and orientation from lite to lite.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and protect glazing materials in accordance with the written instructions of the glazing material manufacturers.
- B. Deliver film to Project site, and handle/store in accordance with manufacturer's instructions, in unopened containers and in a manner that will ensure no deterioration of, or detrimental effects on, film and its system for adhering to glass. Protect from weather and physical abuse.

1.8 WARRANTY

- A. Laminated Glass Special Warranty: Written warranty signed by the glass fabricator and addressed to the Owner agreeing to promptly furnish replacements of laminated glass units that deteriorate within specified warranty period. Defects include edge separation, delamination materially obstructing vision through glass, blemishes and other defects defined in Section 088000. Promptly furnish replacement glass units, including labor for installation, for deteriorated glass units at no cost to the Owner where such deterioration is reported within the Warranty period.

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

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

- A. Refer to Finish Schedule on the Drawings for the extent of glass types and locations. The Contractor shall confirm the levels of heat-treatment required for each glass type scheduled as contained in "Performance Requirements" and "Quality Assurance" Articles.

2.2 PERFORMANCE CRITERIA

- A. General: Provide and install glazing systems capable of withstanding impact loads without failure of any kind, including loss or breakage of glass, failure of seal or gaskets, exudation of glazing sealants, and excessive deterioration of glazing materials.
- B. Glass Design For Interior Glazing: Glass thicknesses and heat treatments indicated are minimum requirements. Glazing details shown are for convenience of detailing only and are to be confirmed by the Contractor relative to cited standards and final framing details.
 - 1. At hollow metal framed, and interior aluminum door and frame openings, provide glass thickness such that the center of glass deflection at a full lateral pressure of 5 psf (239 Pa) in a direction normal to the plane of the wall shall not exceed 1/2 inch (13 mm). Confirm glass thicknesses and heat treatments, as required to meet the performance requirements.
 - 2. Confirm glass thicknesses and heat treatments, as required to meet the performance and testing requirements specified in Section 084113 "Aluminum-Framed Entrances and Storefronts"

2.3 PRIMARY FLOAT GLASS

- A. Float Glass: ASTM C 1036, Type I (transparent glass, flat), Quality q3 (glazing select); Class 1, ultra clear low iron with visible light transmission of not less than 91 percent as indicated in Finish Schedule on the Drawings. Quality q3 shall apply regardless of glass thickness.
 - 1. Ultra Clear, Low Iron Glass: Where indicated in the schedules clear, low iron glass shall mean low iron products as follows:
 - a. AGC Interpane subsidiary of Asahi Glass Co. Ltd.; Krystal Klear.
 - b. Guardian Industries Corp.; UltraWhite.
 - c. Pilkington North America; Optiwhite.
 - d. Vitro S.A.B. de C.V.; Starphire.

2.4 HEAT-TREATED FLOAT GLASS

- A. General: Heat-treat glass where required to meet safety glazing requirements.
- B. Sizes and Cutting: Prior to heat treatment, cut glass to required sizes as determined by accurate measurement of openings to be glazed, making allowance for required edge clearances. Cut and process edges in accordance with glass manufacturer's recommendations. Do not cut or treat edges in the field. Make all internal cuts for hardware, access, or glass-mounted trim or accessories before heat treating.
- C. Fully Tempered Glass: Provide glass complying with ASTM C 1048, Kind FT, and meeting the requirements of ANSI Z97.1 for Category A performance and 16 CFR 1201 for Category II performance. Surface compression shall be equal to or greater than 10,000 psi (69 MPa). After tempering, heat-soak 100 percent of all fabricated glass units to European Union Standard EN14179 to reduce the potential for inclusion related glass breakage. Statistical heat soaking shall not be permitted.

2.5 LAMINATED GLASS

- A. Laminated Glass: Comply with ASTM C 1172 for kinds of laminated glass indicated and other requirements specified, including those in the Glass Schedule.
- B. Interlayer: Minimum 0.060 inch (1.5-mm) thick polyvinyl butyral (PVB) sheet or ionoplast sheet interlayer material with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.
 - 1. All interlayer furnished for the Project shall have been manufactured by one of the following:
 - a. Eastman Chemical Company.
 - b. Kuraray.
- C. Laminating Process: Prior to laminating, cut glass to required sizes and profiles as determined by accurate measurement of openings to be glazed, making allowance for required edge clearances. Cut and process edges in accordance with glass manufacturer's recommendations. Do not cut or treat edges in the field. Fabricate laminated glass to produce glass free of scuff vinyl markings, handprints, tag residue, and foreign substances such as lint, hair, vinyl shavings in the central glass area and the outer 20 percent area when viewed from a distance of 39 inches (1 meter) and 10 feet (3048 mm), respectively. Handprints, tag residue, scuff vinyl markings and foreign substances must be separated by more than 12 inches (300 mm) if not detectable at less than the viewing distances. Delaminations, blow ins, short interlayers, and air or gas pockets shall not be permitted in the central glass area. In the outer 20 percent area, delamination will not be permitted; blow-ins, air or gas pockets, and short interlayers shall be limited to a maximum dimension of 3/32 inch (2.38-mm) in diameter, 3/32 inch (2.38-mm) in diameter, and 1/16 inch (1.5-mm) long, respectively. Laminate units as follows:

1. Laminate lites with interlayer in autoclave with heat plus pressure.

2.6 GLAZING SEALANTS

- A. Gasket, Blocking, and Spacer Wet Glazing Materials: Silicone, compatible with and adherent to each material it will be in contact with, as recommended by the manufacturer to fulfill performance requirements.

2.7 GLAZING GASKETS

- A. Dense Compression Gaskets: Continuous extruded EPDM with cross-sectional profile, physical properties, and tolerances as recommended by the glass manufacturer, and as required to comply with the performance requirements specified and shown, all in compliance with the applicable provisions of ASTM C 864, Option II.

2.8 DECORATIVE WINDOW FILM

- A. Applied Film: A water resistant, permanent, translucent patterned vinyl film laminated to a clear pressure sensitive adhesive and transparent synthetic liner.

1. Color and Pattern: Refer to the Finish Schedule.

2.9 MISCELLANEOUS GLAZING MATERIALS

- A. General: Obtain glazing materials complying with the referenced glazing standards, the glass manufacturers recommendations, and in the size, shape and material for the glazing applications indicated.
- B. Sealers, Primers and Cleaners: Products recommended in writing by the glazing, gasket or sealant manufacturer.
- C. Setting Blocks: EPDM complying with ASTM C 864 (Option II), blocks, 85 +/- 5 Shore A durometer hardness, 1/16 inch (1.5 mm) less than the channel width, and length based on the face area the glass unit to be supported in accordance with GANA standards and glass manufacturer recommendations but not less than 4 inches (101.6 mm).
- D. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

2.10 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

- A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.
 - 1. Edge and Surface Conditions: Comply with the recommendations of AAMA CW-12 "Structural Properties of Glass" for "clean-cut" edges, except comply with manufacturer's recommendations when they are at variance therewith.
- B. Cutting: Do not nip glass edges. Edges may be wheel cut or sawed and seamed at manufacturer's option. For glass to be cut at site, provide glass 2 inches (50.8 mm) larger than required in both dimensions, so as to facilitate cutting of clean cut edges without the necessity of seaming or nipping. Do not cut, seam, nip or abrade heat-treated glass.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, adjacent construction and conditions under which the Work is to be installed. Correct unsatisfactory conditions before proceeding with installation.

3.2 PREPARATION

- A. Clean glazing stops, glazing channels, and rabbets which will be in contact with the glazing materials immediately before glazing. Loose particles present or resulting from fabrication and cleaning shall be removed by blowing out joints with oil-free compressed air, or by vacuuming joints. Remove protective coatings, oils from cutting and drilling operations, and residue on metallic surfaces with solvents that leave no residue. Do not allow solvent to air dry without wiping. Use only lint-free towels for wiping of surfaces. Wipe metal surfaces with IPA (isopropyl alcohol).
 - 1. Prime surfaces to receive glazing compounds. When priming, comply with wet glazing manufacturer's recommendations.
- B. Inspect each glass unit immediately before installation. Do not install any units which are improperly sized or have damaged edges, scratches or abrasion, or other evidence of damage. Remove labels from glass immediately after installation.

- C. Substrate Preparation for Applied Film: Clean glass surfaces to receive the application of applied film. Remove foreign deposits, including paint spatter and glazing sealant materials that have migrated from glazing channel. Wash with detergent, rinse, and dry each glass surface immediately prior to film application; comply with film manufacturer's instructions and recommendations. Control and limit unnecessary activities, occupancies, air movements, and similar incidents in each space of the building during the time of cleaning and film application so as to ensure the best possible environment for application of film on clean substrates. Comply with environmental conditions as recommended by film manufacturer prior to applying film to glass.

3.3 INSTALLATION OF GLAZING, GENERAL

- A. General: Unless otherwise specified or shown comply with the referenced glazing standards and the installation instructions of the glazing, gasket, glass, manufacturers.
 - 1. All glass units shall be installed in accordance with the glass manufacturer's recommendations.
- B. Glazing channel dimensions as indicated on Drawings. Provide necessary bite on glass, minimum edge and face clearances, with reasonable tolerances. Adjust as required by Project conditions during installation.
- C. Setting Blocks: Place setting blocks in sill rabbets in accordance with the referenced glazing standards, unless more stringent requirements are recommended by glass manufacturer. Place blocks to allow water passage to weep holes. Adhere blocks with silicone sealant.
 - 1. For Glass Units Less Than 72 Inches (1830 mm): Locate setting blocks at sill one-quarter of the width in from each end of the glass unless otherwise recommended by the glass manufacturer.
 - 2. For Glass Units 72 Inches (1830 mm) or Greater: Locate setting blocks at sill one-eighth of the width in from each end of the glass, but not less than 6 inches (150 mm), unless otherwise recommended by the glass manufacturer.
- D. Place edge blocking to prevent glass units from walking (moving sideways) in the jamb rabbets, to ensure against glass to metal contact within the rabbet, and ensure adequate bite on the glass within the glazing system. Blocking shall be sized and located to comply with the glass manufacturer's recommendations and the referenced glazing standards.
- E. Place glass units with uniform draw, bow, and pattern, producing the greatest possible degree of uniformity in appearance on the entire wall elevation.

- F. Film Application: Comply with film manufacturer's installation requirements, instructions, and recommendations. Avoid seams whenever possible and, where not possible, minimize the number of seams. Produce seams which are tightly-butt, without overlaps and gaps which are visible only at viewing distances of 20 inches (508 mm) and less. Apply film by method which will ensure the inclusion of no air bubbles or other foreign substances.
1. Extend film to cover full expanse of each glass sheet to receive film, but without either overlapping the glass glazing materials, or leaving edge gaps of more than 1/32 inch (0.8 mm).
 2. In order to minimize the possibility of visible differences in the color or shading intensity of the butted films at seams, apply each film with its butted edge taken from the same end of the film roll (reverse the direction-of-application). Remove and replace film application where mismatching of film is visually noticeable where directed by Architect.
 3. Exercise extreme care during application of film, including the cutting and pressing-in-place of film, so as to avoid the scoring and abrading of surfaces of glass.
 4. Adhere film to glass using procedures recommended by film manufacturer. Press into place to ensure that entire film sheet, including edges, are firmly and permanently adhered.

3.4 PROTECTION

- A. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way and from any source, including natural causes, accidents, and vandalism.
- B. Glass and Film Washing: Comply with the written recommendations of the glass and film manufacturer for materials and procedures in cleaning glass and film. Both exposed surfaces of glass units shall be washed no greater than 4 days before the Architects final inspection for Substantial Completion.

END OF SECTION

SECTION 088300 - MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes wall mounted float glass mirrors.

1.2 ACTION SUBMITTALS

- A. Product Data: Submit product data for each product indicated, including description of materials and process used to produce mirrored glass, source of glass, glass coating components, edge sealer, and quality control provisions.
- B. Shop Drawings: Submit shop drawings showing plans, elevations, sections, details, and attachments to other Work.
- C. Samples: Submit samples, 12 inches (300 mm) square in size, of each type of mirror glass specified including edge treatment on two adjoining edges of samples.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: Submit product certificates signed by manufacturers of mirror glass certifying that their products and edge sealers comply with specified requirements.
- B. Preconstruction Test Report: Submit mirror mastic glass coating compatibility test reports from organic protective coating manufacturer indicating that mirror mastic has been tested for compatibility and adhesion with organic protective coating. Include organic coating manufacturers' interpretation of test results relative to performance and recommendations for use of mastics with organic protective coating.
- C. Warranty: Submit special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed work similar in material, design, and extent to that indicated; whose work has resulted in installations with a record of not less than 5 years of successful in-service performance.
- B. Glazing Publications: Comply with the applicable recommendations of the following. Where recommendations conflict the more stringent shall apply:

1. Glass Association of North America (GANA): "Glazing Manual" and the Mirror Division's "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."
2. National Glass Association (NGA): "Custom Mirrors, Fabrication and Installation."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with mirrored glass manufacturer's written instructions for shipping, storing, and handling mirrored glass as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors, protected from moisture including condensation.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrored glass units that deteriorate f.o.b. the nearest shipping point to Project site, within five years from date of Substantial Completion.
 1. Deterioration of Silvered Mirrored Glass: Defects developed from normal use not caused by maintaining and cleaning mirrored glass contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

PART 2 - PRODUCTS

2.1 FABRICATION

- A. Cutouts: Fabricate cutouts for notches and holes in mirrored glass without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrored glass.
- B. Mirror Edge Treatment:
 1. Cutting and Polishing: Flat edges where the clean cut "square" edge of the glass is flat and surface edges are slightly arressed. After grinding the arisses, edges shall be polished to a high gloss surface where the surface reflectivity is similar in appearance to the major surface of the glass.
 2. Edge Sealing: Immediately after cutting to final sizes, and applying edge treatment, factory seal edges of mirrors with edge sealer to prevent chemical or atmospheric penetration of glass coating.

2.2 MISCELLANEOUS MATERIALS

- A. Setting Blocks: Non-rubber or non neoprene based elastomeric material manufactured for setting silvered flat glass mirrors, compatible with adhesive used for placement, with a Type A Shore durometer hardness of 85, plus or minus 5. 1/8 inch (3.18 mm) wide by 1/4 inch (6.35 mm) high by 4 inches (101.6 mm) long.
- B. Edge Sealer: Coating compatible with glass coating and approved by mirrored glass manufacturer for use in protecting against silver deterioration at mirrored glass edges.
- C. Mirror Mastic: An adhesive setting compound, produced specifically for mechanically securing and setting mirrored glass by spot application and not containing asbestos and containing not more than 70 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24); one of the following:
 - 1. Super Set Mirror Mastic by Palmer Products Corporation, Louisville, KY.
 - 2. Premiere Plus by Gunther Mirror Mastics division of Royal Adhesives & Sealants, South Bend, IN.
- D. Drywall and Plywood Paint: A high quality flat coating or primer of type as recommended by the mirror mastic manufacturer.
 - 1. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limit for VOC content, when calculated according to 40 CFR 59, Subpart D (EPA Method 24) (ASTM D 3960):
 - a. Flat Coating or Primers: VOC content of not more than 50 g/L.
- E. Top and Bottom Stainless Steel J Channels: J-channels with return deep enough to produce a glazing channel to accommodate 6 mm thick mirrors and heavy bodied mirror mastic specified and in lengths required to cover bottom and top edges of each mirror in a single piece. The ends of the back lips of all channels shall be factory snapped and filed so that they will not be seen after installation. The bottom channel shall be drilled with a minimum of two 1/4 inch (6.35 mm) diameter weep holes located between the setting blocks.
 - 1. Bottom and Top Trim: J-channels formed with front leg and back leg not less than 5/16 and 7/8 inch (8 and 22 mm) in height, respectively.
 - a. Product:
 - 1) C. R. Laurence Co., Inc.; CRL Stainless Steel "J" Channel, No. SS960.

- F. Top and Bottom Aluminum J Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate 6 mm thick mirrors and heavy bodied mirror mastic specified and in lengths required to cover bottom and top edges of each mirror in a single piece. The ends of the back lips of all channels shall be factory snipped and filed so that they will not be seen after installation. The bottom channel shall be drilled with a minimum of 2-1/4 inch (57 mm) diameter weep holes located between the setting blocks.
1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 inch and 7/8 inch (9.5 and 22.2 mm) in height, respectively. CRL Polished Finish 1/4 inch Standard "J" Channel (Part Number D636P); C. R. Laurence Co., Inc.
 2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 inch and 1-3/16 inch (15.8 mm and 30.1 mm) in height, respectively. CRL Polished Finish 1/4 inch Deep Nose "J" Channel (Part Number D645P); C. R. Laurence Co., Inc.
- G. Fasteners:
1. Steel Stud Framing: For fastening J-channels to drywall stud and backer sheet framing provide #8 gage diameter, 1 inch (25.4 mm) long, Phillips type pan head drywall screws in quantity as required for support and fastening of continuous j-molds to drywall stud framing.
 2. Plywood Fasteners: Provide #8 gage diameter, minimum 1 inch (25.4 mm) long, Phillips flat countersunk head, sharp pointed, coarse threaded, zinc coated, steel wood screw fasteners in quantity as required for support and fastening of continuous j-molds to plywood substrates.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Comply with mastic manufacturer's written installation instructions for preparation of substrates.
1. Mirror, drywall and plywood substrates shall be free of dust, be clean, and dry prior to application of mirror mastic and drywall and plywood paint. If plywood or drywall surfaces have been painted prior to application of the specified drywall and plywood paint the existing paint shall be sanded through to the original surface and the substrate cleaned prior to the application of drywall and plywood paint.

3.2 GLAZING

- A. General: Install mirrors with mirror glazing channels to comply with written instructions of mirror and mirror glazing channel manufacturers, with referenced GANA and NGA publications, and as specified. Mount mirrors plumb, in line, and in a manner that avoids distorting reflected images.

- B. Comply with mastic manufacturer's printed directions for preparation and sealing of mounting surfaces by sealing drywall, and plywood, substrates with drywall and plywood paint. Allow paint to dry before applying mirror mastic.
- C. Mirror Channel Installation:
1. To Plywood: Drill, do not dimple, back lip of channel to receive fasteners with holes properly sized and spaced to receive fasteners. Attach mirror channels by screw attaching mirror channel through the back lip of the channel to plywood substrate in accordance with the fastener manufacturer's written instructions. Install the web of the top channel 1/4 inch (6.35 mm) higher than the height of the mirror to allow the raising of the mirror into the top channel and its subsequent lowering onto the bottom channel. After installing fasteners place masking tape over the entire length of the back lip of the channel completely covering the fastener heads to protect the mirror from being chipped in setting. Adhere setting blocks at quarter points for bottom mirror channels using only two setting blocks per mirror panel.
 2. To Drywall: Drill and countersink, do not dimple, back lip of channels to receive stud fasteners with holes properly sized and spaced to receive stud fasteners. Attach mirror channels by screw attaching mirror channel through the back lip of the channel through drywall, stud framing, and sheet metal backer plate substrates in accordance with the fastener manufacturer's written instructions.
 - a. Install the web of the top channel 1/4 inch (6.35 mm) higher than the height of the mirror to allow the raising of the mirror into the top channel and its subsequent lowering onto the web of the bottom channel. After installing fasteners place masking tape over the entire length of the back lip of the channel completely covering the fastener heads to protect the mirror from being chipped in setting. Adhere setting blocks to the web of the bottom mirror channels, located at quarter points, using two setting blocks per mirror panel.
- D. Mirror Installation: Apply mastic in vertical beads or mounds to the wall, not to the mirror back to avoid potential damage caused by mastic applicator tools, in compliance with mastic manufacturer's written instructions to allow air circulation between back of mirrors and face of mounting surface. Each vertical bead shall be approximately 1/2 inch (12.7 mm) in width with a minimum of one bead for every square foot of mirror. Each mound shall be approximately 1-1/2 inches (38 mm) in diameter with a minimum of one mound for every square foot of mirror. Do not apply mastic within 6 inches (150 mm) of the mirror edges to prevent squeeze out. Place beads or mounds so space will be left between them when the mirror is installed. After mastic is applied, align mirrors and press into place. Each vertical bead shall spread to approximately 2 inches (50.8 mm) in width and each mound shall spread to a pat approximately 3-1/2 inches (89 mm) in diameter after pressing mirror into place.

3.3 PROTECTION AND CLEANING

- A. Protect mirrored glass from breakage and contaminating substances resulting from construction operations. Using clean warm water, clean mirrors by methods recommended in referenced glazing standards.

END OF SECTION

SECTION 088700 - ARCHITECTURAL WINDOW FILMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Architectural window film.

1.2 REFERENCES

- A. ASHRAE - American Society for Heating, Refrigeration, and Air Conditioning Engineers; Handbook of Fundamentals.
- B. ASTM International (ASTM):
 - 1. ASTM E 84 - Standard Method of Test for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E 308 - Standard Recommended Practice for Spectrophotometry and Description of Color in CIE 1931 System.
 - 3. ASTM E 903 - Standard Methods of Test for Solar Absorbance, Reflectance and Transmittance of Materials Using Integrating Spheres.

1.3 PERFORMANCE REQUIREMENTS

- A. Fire Performance: Surface burning characteristics when tested in accordance ASTM E 84:
 - 1. Flame Spread: 25, maximum.
 - 2. Smoke Developed: 450, maximum.

1.4 SUBMITTALS

- A. Submit under provisions of Section 013000 - Administrative Requirements.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- D. Verification Samples: For each finish product specified, two samples representing actual product, color, and patterns.

1.5 **QUALITY ASSURANCE**

- A. **Manufacturer Qualifications:** All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten (10) years experience.
- B. **Installer Qualifications:** All products listed in this section are to be installed by a single installer with a minimum of five (5) 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 five 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.
 - e. Amount of film installed.
 - f. Date of completion.

1.6 **DELIVERY, STORAGE, AND HANDLING**

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

1.7 **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 absolute limits.

1.8 **WARRANTY**

- A. At project closeout, provide to Owner or Owners 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

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Solyx.

1. Product: SX-1325 Semi-Transparent Clear Frost Window Film.
2. Adhesive Color: Clear.
3. Adhesive Type: Pressure Sensitive.
4. Backing: Acrylic Pressure Sensitive Adhesive.
5. Brand: Solyx.
6. Film Thickness: 3-4 mil.
7. Film Type: Embossed Vinyl.
8. Opacity: Translucent.
9. Visible Light Transmittance: 86%.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. 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.
- C. 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.
- D. Apply film to glass and lightly spray film with slip solution.

- E. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.
- F. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.
- G. 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.

3.4 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 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes non-structural metal framing assemblies for interior partitions and suspended gypsum board ceilings.

1.2 INFORMATIONAL SUBMITTALS

- A. Embodied Carbon Reporting: Type III Environmental Product Declarations, per ISO 14025 disclosing the Global Warming Potential of the product from Stages A1 through A3 in accordance with Section 010000 "General Requirements" for products listed under "Embodied Carbon Reporting" in Article "Quality Assurance."
- B. Material Ingredient Disclosure: Submit one of the following reports for products listed under "Material Ingredient Disclosure" in Article "Quality Assurance."
 - 1. Health Product Declaration.
 - 2. UL Product Lens.
 - 3. Living Building Challenge Declare Label or Living Product Challenge Label.
 - 4. EPEA Material Health Statement.
 - 5. Cradle-to-Cradle v4 Material Health Certificate or multi-attribute certificate.
- C. Sustainability Reporting: Provide the following for steel products.
 - 1. Recycled content, including Pre-consumer and post-consumer percentages.
 - 2. Manufacturing location.
 - 3. End of Life: Recyclability post-consumer.

1.3 QUALITY ASSURANCE

- A. Embodied Carbon Reporting: Obtain products with the following publicly available, third-party verified Type III Environmental Product Declaration (EPDs) in accordance with Section 010000 "General Requirements":
 - 1. Steel Partition and Soffit Framing: Channels, suspension systems for ceiling grids, studs, runners and track.
- B. Material Ingredient Disclosure: Obtain the following products with publicly available reports disclosing material ingredients to residuals no greater than 1000ppm:
 - 1. Steel Partition and Soffit Framing: Channels, suspension systems for ceiling grids, studs, runners and track.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Gypsum Board Assembly Deflections:

1. Typical Walls: Wall assemblies shall be constructed for deflection not to exceed 1/240 of the wall height when subjected to a positive and negative pressure of 5 psf (239 Pa).
2. Walls with Tile Finish: Wall assemblies to receive tile finishes shall be constructed for deflection not to exceed 1/360 of the wall height when subjected to a positive and negative pressure of 5 psf (239 Pa).
3. Ceilings, bulkheads, soffits, ceiling transitions, ledges, and coves shall be constructed for a deflection not to exceed 1/360 of the distance between supports.

2.2 STEEL SUSPENDED CEILING FRAMING

- A. Studs and Runners: ASTM C 645. Use 0.0312 inch (0.79 mm) minimum base metal thickness and minimum depth as required to suit deflection criteria.
- B. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625 inch (1.59 mm) diameter wire, or double strand of 0.0475 inch (1.21 mm) diameter wire.
- C. Hanger Attachments to Overhead Decks: Suitable for application indicated, fabricated from corrosion-resistant materials, with eyepins, clips or other devices for attaching hangers and capable of sustaining, without failure, a load equal to 10 times that imposed by the complete ceiling system.
- D. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162 inch (4.12 mm) diameter.
1. Rod Hangers: ASTM A 510 (ASTM A 510M), mild carbon steel.
 - a. Diameter: 1/4 inch (6.3 mm).
 - b. Protective Coating: ASTM A 153/A 153M, hot-dip galvanized.
- E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch (1.37 mm), a minimum 1/2 inch (12.7 mm) wide flange, with manufacturer's standard corrosion-resistant zinc coating.
- F. Furring Channels (Furring Members): Commercial-steel sheet with ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized zinc coating. No equivalent coatings allowed.
1. Cold Rolled Channels: 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flange, 3/4 inch (19 mm) deep.
 2. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22.2 mm) deep.

- a. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).

2.3 STEEL PARTITION AND SOFFIT FRAMING

- A. General: Provide steel framing members sized and spaced as indicated but not less than that required to comply with ASTM C 754 for conditions indicated.
 - 1. In areas where top of partitions are dependent on ceiling system for lateral support, coordinate design and installation to comply with specified deflection limitations.
 - 2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized zinc coating. No equivalent coatings (EQ) allowed.
- B. Steel Studs and Runners: ASTM C 645, in minimum depth indicated in partition type details.
 - 1. Minimum Base Metal Thickness: As required to comply with deflection criteria but not less than 0.0179 inch (0.45-mm) (typical partitions), 0.033 inch (0.84 mm)(minimum thickness at partitions supporting wall mounted casework).
 - 2. Depth: As indicated.
- C. Flat Strap and Backing Plate: 36 inch (914 mm) wide by 6 inch (150 mm) high steel sheet for blocking and bracing required for the attachment of surface mounted items and accessories indicated. Locate to span a minimum of 2 studs.
 - 1. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).
- D. Cold-Rolled Channel Bridging: For channel bridging for fixture attachment or lateral bracing provide 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flange:
 - 1. Depth: 1-1/2 inches (38.1 mm).
 - 2. Clip Angle: 1-1/2 by 1-1/2 inch (38.1 by 38.1 mm), 0.068 inch (1.73 mm) thick, galvanized steel.
- E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
 - 2. Depth: 7/8 inch (22.2 mm).
- F. Resilient Furring Channels: 1/2 inch (12.7 mm) deep, steel sheet members designed to reduce sound transmission.
- G. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members securely to substrates involved; complying with the recommendations of the gypsum board manufacturers for applications indicated.

2.4 AUXILIARY MATERIALS

- A. Isolation Strip at Exterior Walls: Adhesive-backed, closed-cell, compressible, non-extruding, sound transmission reducing, vinyl foam tape strips with approximately 13 Shore 00 hardness that allow fastener penetration without foam displacement, 0.75 inch (19 mm) thick, in width 1/2 inch (12.7 mm) less than window mullion width.
 - 1. V7324 Norton Sealant Tape; gray color.
- B. Metal Post for Tube Framing at Partial Height Walls: Refer to Section 055000 "Metal Fabrications."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordination with Sprayed Fire-Resistive Materials: Remove sprayed fire-resistive materials only to extent necessary for installation of the non-structural metal framing and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.2 INSTALLING STEEL FRAMING, GENERAL

- A. General: Install steel framing to comply with ASTM C 754, ASTM C 840 and the gypsum board manufacturer's recommendations; where standards conflict the more stringent shall apply.
- B. Install supplementary framing, blocking, backerplates and bracing at locations in gypsum board assemblies which are indicated to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."

3.3 INSTALLING STEEL SUSPENDED CEILING FRAMING

- A. Suspended Ceiling Framing: Suspend ceiling hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
- B. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member and transversely between parallel members.

3.4 INSTALLING STEEL PARTITION AND SOFFIT FRAMING

- A. Install continuous runners (tracks) sized to match studs at floors, ceilings, and structural walls and columns where gypsum board stud assemblies abut other construction. Secure runners to substrates with fasteners spaced a maximum of 24 inches (600 mm) on center unless closer spacing is recommended by the framing manufacturer for the floor and ceiling construction involved. Provide fasteners at all corners and ends of runner tracks.
 - 1. Where studs are installed directly against exterior walls, install foam gasket isolation strip between studs and wall.
 - 2. Install two beads of sealant below floor tracks for acoustical and dust control.
- B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by the faces of adjacent framing.
- C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings and at partial height partitions. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
- D. Install backerplates for support of wall mounted items.
- E. Isolation Strip Attachment: Where partitions abut exterior wall window mullions, and partition filler panels are not indicated, adhesively attach isolation strips to window mullions. Center isolation strips on mullion to form a continuous, sound resistant and lightproof, recessed joint seal for the entire length of the interface between the partition studs and trim members and the vertical window mullions.

END OF SECTION

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes gypsum wallboard for partitions and ceilings, and tile backer boards.

1.2 INFORMATIONAL SUBMITTALS

- A. Embodied Carbon Reporting: Type III Environmental Product Declarations, per ISO 14025 disclosing the Global Warming Potential of the product from Stages A1 through A3 in accordance with Section 010000 "General Requirements" for products listed under "Embodied Carbon Reporting" in Article "Quality Assurance."
- B. TVOC Emissions: Laboratory test reports or third-party certificates showing compliance with the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers" version 1.2-2017.
- C. Material Ingredient Disclosure: Submit one of the following reports:
 - 1. Health Product Declaration.
 - 2. UL Product Lens.
 - 3. Living Building Challenge Declare Label or Living Product Challenge Label.
 - 4. EPEA Material Health Statement.
 - 5. Cradle-to-Cradle v4 Material Health Certificate or multi-attribute certificate.
- D. Sustainability Reporting: Provide the following:
 - 1. Recycled content, including Pre-consumer and post-consumer percentages.
 - 2. Biobased content.
 - 3. Manufacturing location for ceiling products.
 - 4. End of Life:
 - a. Type X Gypsum Board: Third-party partnership for product recovery and recycling.
 - b. Sound Attenuation Blankets: Manufacturing Take-Back Program or Third-party partnership for product recovery and recycling.

1.3 QUALITY ASSURANCE

- A. Embodied Carbon Reporting: Obtain products with the following publicly available, third-party verified Type III Environmental Product Declaration (EPDs) in accordance with Section 010000 "General Requirements":

1. Type X 5/8-inch gypsum board: Product-Specific EPDs.
 2. Sound attenuation blankets: Industry-wide or Product-specific EPDs.
- B. TVOC Emissions: Obtain the following products with publicly available reports or certificates verifying compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers" version 1.2-2017, following the private office scenario:
1. Type X 5/8-inch gypsum board.
 2. Sound attenuation blankets.
- C. Material Ingredient Disclosure: Obtain the following products with publicly available reports disclosing material ingredients to residuals no greater than 1000ppm:
1. Type X 5/8-inch gypsum board.
 2. Sound attenuation blankets.
- 1.4 ENVIRONMENTAL CONDITIONS
- A. Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.1 Performance Requirements

- A. STC-Rated Assemblies: Provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency. STC-rated assemblies are indicated by design designations from GA-600, "Fire Resistance Design Manual."

2.2 GYPSUM BOARD

- A. Gypsum Board for Wall, Soffit, and Ceiling Surfaces: ASTM C 1396/C 1396M, Type X; 5/8 inch (15.9 mm) thick, long edges tapered.
1. Embodied Carbon: Maximum Global Warming Potential for Production Stages A1 through A3 as defined in Section 010000 "General Requirements": 3.3 kg of CO₂eq per m².
 2. One of the following:
 - a. EcoSmart Firecode X, USG.
 - b. Type X 5/8-inch Gypsum Board, CertainTeed.
 - c. 5/8-inch TouchRock Fireguard X, Georgia-Pacific.

- B. Flexible Gypsum Board for Curved Surfaces: ASTM C 1396/C 1396M, 1/4 inch (6.3 mm) thick, long edges tapered; manufactured to bend to fit tight radii and to be more flexible than standard regular-type panels of the same thickness. Apply in double layer at curved assemblies.

2.3 Tile Backing Panels

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with core type indicated, 5/8 inch thickness. Available products include:
 - 1. G-P Gypsum Corp.; Dens-Shield Tile Backer.
 - 2. National Gypsum Company; GOLD BOND Brand EXP Tile Backer.
 - 3. USG; Durock Brand Glass-Mat Tile Backerboard.
- B. Cementitious Backer Units for Installation of Glass Tile: ANSI A118.9, 1/2 inch (12.7 mm) thickness.

2.4 GYPSUM BOARD ACCESSORIES AND FINISHING MATERIALS

- A. Interior Steel Trim Accessories: ASTM C 1047; galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
- B. Aluminum Trim Accessories: ASTM B 221, Alloy 6063-T5.
- C. Joint Tape: Comply with ASTM C 475/C 475M.
 - 1. Interior Gypsum Board: Paper.
 - 2. Tile Backing Panels: As recommended by panel manufacturer.
- D. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
- E. Joint Compound for Tile Backing Panels: As recommended by manufacturer.
- F. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
- G. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing).
 - 1. Embodied Carbon: Maximum Global Warming Potential for Production Stages A1 through A3 as defined in Section 010000 "General Requirements": 3.3 kg of CO₂eq per m².
- H. Acoustical Joint Sealant: ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings as demonstrated by testing according to ASTM E 90, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24). Provide one of the following:

1. SHEETROCK Acoustical Sealant; U.S. Gypsum.
2. AC-20 FTR; Pecora.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and finish gypsum panels to comply with ASTM C 840, GA-216, and the gypsum board manufacturer's recommendations, where standards conflict, the more stringent shall apply.
- B. For STC-rated assemblies, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
- C. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4 to 1/2 inch (6.3 to 12.7 mm) wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- D. Install 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.
- E. Install corner beads at external corners.
- F. Install interior trim accessories where edge of gypsum panels would otherwise be exposed or semiexposed. Provide interior trim accessories with face flange formed to receive joint compound.
- G. Install aluminum trim accessories where indicated.
- H. Install control joints in locations indicated and where directed by the Architect for visual effect, or if not indicated or directed by the Architect, provide control joints in accordance with ASTM C 840.

3.2 FINISHING GYPSUM BOARD

- A. Prefill open joints and damaged surface areas.
- B. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

- C. Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
1. Level 1: Ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for sound-rated assemblies.
 2. Level 2: Panels that are substrate for tile and where indicated.
 3. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.
 4. Level 5: Over entire surface of gypsum board ceilings and soffits, and where gypsum board is indicated to receive wall coverings, semi-gloss and high gloss paints.

END OF SECTION

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes ceramic, porcelain, quarry, and glass tile.

1.2 PERFORMANCE REQUIREMENTS

- A. General: Provide floor tiles complying with the following standard and performance requirement.

1.3 ACTION SUBMITTALS

- A. Product Data: For each product indicated.
- B. Sustainable Design Submittals: Refer to Division 01 Section "Sustainable Design Requirements."

1.4 INFORMATIONAL SUBMITTALS

- A. Test Reports: Submit test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of tile products with requirements specified for slip resistance.
- B. Master Grade Certificates: Submit master grade certificates for each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- C. Product Certificates: Submit manufacturer's certifications for each type of grout and bonding material being provided suitable for the intended use and meet or exceed the referenced standards and the requirements of this Specification.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Instructions: Submit maintenance instructions for each type of product specified.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Provide attic stock equal to the following for each type, color, pattern, and size (or fraction thereof) of tile provided for the Project. Supply in manufacture's unopened containers, identified with name, brand type, grade, class and all other qualifying information, to a location where directed by the Owner.

1. Two percent of amount installed but not less than one box.

1.7 QUALITY ASSURANCE

- A. Installer: Engage an installer, with a minimum of 5 years of successful commercial tile installations similar in material, design, and scope to that indicated.
- B. Source Limitations for Tile: Obtain each tile type from one source or producer, and from same production run, and of consistent quality in appearance and physical properties for each contiguous area.

1.8 DELIVERY STORAGE AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.
- B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.
- B. Maintain temperatures within range recommended by the mortar and grout manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C), in spaces during tile setting. After installation maintain temperatures within range recommended by the mortar and grout manufacturer

PART 2 - PRODUCTS

2.1 TILE PRODUCTS, GENERAL (TL<##>)

- A. ANSI Ceramic Tile Standard: Provide 'Standard Grade' tile that complies with ANSI A137.1 "Specifications for Ceramic Tile," ANSI A137.2, "Specifications for Glass Tile," ANSI A137.3, "Specifications for Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs" for types, compositions, and other characteristics indicated.
 1. Products and Manufacturers: Provide tile matching the Architect's samples which have been selected from the product lines and manufacturers indicated in Finish Schedule on Drawings.

- B. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.
- C. Tile Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing where applicable.
- D. Rectified Tile Edges: Provide all tile units having a face dimension of greater than 8" x 8" (200 x 200 mm) with factory rectified edges.

2.2 SETTING AND GROUTING MATERIALS

- A. Manufacturers and Plant Locations: Provide products manufactured in the plant closest to the geographic location of the project.
- B. Source Limitations: For each tile installation, obtain compatible formulations of setting and grouting materials and waterproofing materials containing latex or latex additives from a single manufacturer.
- C. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.1A and as specified below:
 - 1. Reinforcing Wire Fabric: Galvanized, flat, welded wire fabric, 2-inch by 2-inch by 0.062-inch (50.8-mm by 50.8-mm by 1.57-mm) diameter; comply with ASTM A1064 and ASTM A 82 except for minimum wire size.
 - 2. Latex Additive: Manufacturer's standard styrene-butadiene-rubber water emulsion, serving as replacement for all gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.
 - 3. Premixed Dry Mortar Material: One of the following:
 - a. Laticrete 226 Thick Bed Mortar Mix; Laticrete International, Inc.
 - b. Modified Mortar Bed; MAPEI Corporation.
 - c. Ardex Americas; Ardex AR 300.
- D. Polymer-Modified Tile Grout (For Typical Applications): Complying with ANSI A118.7 compounded with calcium aluminate cement, non-shrinking, efflorescence free grout. Provide, and stockpile, grout for each exposed color from a single manufactured and packaged batch source for the entire Project.
 - 1. Polymer Type: Dry, redispersible latex/polymer powder form, prepackaged with other dry ingredients, one of the following:
 - a. Prism; Custom Building Products.
 - b. Permacolor; Laticrete International Inc.
 - c. Ultracolor Plus FA; Mapei Corporation.
 - d. SikaTile 815 Secure Grout; Sika.
 - e. Ardex Americas; Ardex FL.

2. Colors: As selected by Architect from manufacturers standards to match tile being grouted.
- E. Epoxy Grout (For Bathroom and Pet Relief Applications): Complying with ANSI A118.3, water-cleanable epoxy with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)(ASTM D 3960).
 1. At bathroom and pet relief areas provide the following:
 - a. Kerapoxy CQ; Mapei Corporation.
 - b. SikaTile 825 Epoxy Grout; Sika.
 - c. Ardex Americas; Ardex WA epoxy grout and adhesive.
 2. Colors: As selected by Architect from manufacturers standards to match tile being grouted.

2.3 MISCELLANEOUS MATERIALS

- A. Joint Sealants:
 1. Typical Surfaces: "Mildew-Resistant Silicone Sealant", as specified in Section 079200 "Joint Sealants."
- B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- C. Metal Edge Strips for Wall Applications: Metallic, angle or L-shaped, depth to match tile and setting-bed thickness and having an integral provision for anchorage to substrate; aluminum alloy exposed-edge material; furnish in longest lengths available.
 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. Blanke Corporation.
 - b. Ceramic Tool Company, Inc.
 - c. Schluter Systems L.P.
 - d. DTA Trims and Profiles div. of Ardex.
- D. Divider, Transition, and Movement Joint Strips:
 1. Divider and Transition Strips: Stainless steel shapes and flat bar trims fabricated from ASTM A 666 (for flat bar) and ASTM A 276 (for shapes) Type 304 stainless steel, 1/4 inch (6.35 mm) wide at top edge unless otherwise indicated, depth as required to suit conditions shown and having an integral provision for anchorage to mortar bed or substrate, unless otherwise indicated. Provide NAAMM #4 satin finish at exposed top edge in the long direction, furnish in longest lengths available.

2. Movement Joint Strips: Laminations of extruded aluminum or formed stainless steel angle shapes, depth as required to finish flush with top surface of adjacent tile flooring fields, back to back installed with full height flexible filler to accommodate movement. Control joints shall have either an exposed approximately 5/8 inch (16 mm) wide interlocking continuous top to conceal prefabricated flexible filler or an exposed custom flexible prefabricated filler to accommodate movement. Joint assembly shall have a total movement capability of approximately 1/4 +1/8 inch/-3/32 /inch (5 mm+3 mm/-2 mm). Finish of exposed top to be satin. One of the following:
 - a. Basis of Design: Emseal Series ESF 16 AL; Emseal Joint Systems, Ltd.
 - b. Schluter; Dilex - EDP, fabricated to comply with the specified requirements.
 - c. CTC (Ceramic Tool Company); CTC Joint custom fabricated to comply with the specified requirements.
- E. Paints and coatings shall comply with VOC content as shown in CALgreen Section 5.504.4.3.

2.4 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions. Add materials and liquid latex additives in accurate proportions. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present.
 1. Verify that substrates for setting tile are sound and free of voids, bugholes, rock pockets, honeycombs, and protrusions, and which are dry, clean, free of oil, waxy films, and curing compounds. Grind or scarify concrete substrates to remove existing floor adhesive and mortar residues (if any), laitance, films, sealing and curing compounds if they are determined to be present on the substrate.
 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove paint, coatings, including curing compounds and other substances that are incompatible with tile-setting materials.
- B. Blending: Color blend tiles at Project site before installing.
 - 1. Furnish the same lots, batches, etc. within the same contiguous areas of the site (i.e. corridors on the same floors, common rooms which adjoin each other, etc.).

3.3 INSTALLATION, GENERAL

- A. Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" and the TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" that apply to types of setting and grouting materials and to methods indicated.
- 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. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area beginning at thresholds. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.
- E. Finished Surfaces: Unless otherwise accepted in the sample installation(s), if any, finished surfaces shall present a flat, even appearance, free from waver, projections, and depressions.
- F. Metal Edge Strips: Install where exposed edge of wall tile meets other wall finishes that finish flush with or below face of tile and the manufacturer of the field tile does not manufacture a tile edge transition trim. Where metal edge strips are indicated and full length single units are not available, joints are to be butted, ends shall touch and align.
- G. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout sealer manufacturer's written instructions. As soon as sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 WALL TILE INSTALLATION

- A. Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for ANSI setting bed methods, TCNA installation methods related to types of construction, and grout ANSI installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.
1. Latex Portland Cement Mortar Installation (using specified latex portland cement mortar material): ANSI A108.5.
 2. Gypsum Wallboard, Interior (Latex Portland Cement Mortar) Method: TCNA W243, place tiles maintaining 1/8-inch (3-mm) wide joints, and true accurate pattern as shown.
 3. Cementitious Backerboard (Latex Portland Cement Mortar) Method: TCNA W244C, place tiles maintaining 1/8-inch (3-mm) wide joints, and true accurate pattern as shown.
 4. Grout Installation: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. Comply with Latex-portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar, mounting mesh, or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.
- B. Large Format Wall Tile Installation: Install in accordance with the applicable provisions of ANSI A108.19, the tile manufacturer's recommendations and requirements indicated below for ANSI setting bed methods, TCNA installation methods related to types of construction, and grout ANSI installation methods and grout types. Where recommendations and methods conflict, the tile manufacturer's recommendations shall apply. Exercise care to quickly remove spillage from faces of tile using damp sponges. Rake out joints to depth required to receive grout as tile units are set.
1. Ceramic Tile Type: Indicated in Finish Schedule as tiles with face size greater than or equal to 11 s.f. (1 sq. m).
 2. Latex Portland Cement Mortar Installation (using specified latex portland cement mortar material): ANSI A108.5.
 3. Cementitious Backerboard (Latex Portland Cement Mortar) Method: TCNA W244C, place tiles maintaining 1/8-inch (3-mm) wide joints, and true accurate pattern as shown.
 - a. Place and attach mechanical edge leveling system to backup substrates using a type of edge leveling system recommended by the tile manufacturer to minimize lippage between panels.

- b. With a trowel, having notches sized as recommended by the mortar manufacturer, place and comb the surface of the mortar on the backerboard substrate with the notched side of the trowel removing excess mortar. Spread only as much mortar as can be covered in the time limits established by the mortar manufacturer's recommendations. Troweled ridges shall be combed in a straight line parallel to the shortest dimension of the tile.
 - c. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying mortar to tiles.
 - d. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be placed and combed to back of tile with the notched side of the trowel removing excess mortar. Spread only as much mortar as can be covered in the time limits established by the mortar manufacturer's recommendations. Troweled ridges shall be combed in a straight line parallel to the shortest dimension of the tile.
 - e. Place mortar covered tiles onto mortar covered backerboard mortar bed, maintaining(3-mm) 1/8-inch (3-mm) wide joints, and true accurate pattern as shown. Firmly press from center of the tile to cause the ridges to flatten out and come together in a void free bed. Lightly tamp the surface of the tile with a hard rubber grout float to ensure good contact, do not use a rubber mallet. Exercise care to quickly remove spillage from faces of tile using damp sponges. Rake out joints to depth required to receive grout as tile units are set. Allow mortar to cure a minimum of 48 hours before grouting.
4. Grout: Do not begin grouting tiles until they are firmly set and, in no case, in less than 48 hours after they have been installed. Remove spacers, if any, prior to grouting. Comply with Latex-portland cement: ANSI A108.10. Fill joints of cushion edged tile to the depth of the cushion; fill joints of square edge tile flush with the tile surface. Do not permit mortar or spacer material to show through grouted joints. Provide hard finished grout, which is uniform in color, smooth, and without voids, pinholes, or low spots. Tool surfaces with shallow concave profile.

3.5 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all tile surfaces so they are free of foreign matter.
 - 1. Remove grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
- B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work. Replace all cracked, chipped, and broken tile units with matching tile units; patched tile units will not be permitted.

- C. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
- D. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

END OF SECTION

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for ceilings.

1.2 ACTION SUBMITTALS

- A. Product Data: Submit product data for each type of product indicated.
- B. Shop Drawings: Submit shop drawings of reflected ceiling plans drawn accurately to large scale and coordinating penetrations and ceiling-mounted items. Show the following:
 - 1. Patterns of ceiling suspension assembly members with setting out/work points.
 - 2. Method of attaching hangers to building structure.
 - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.
- C. Samples: Submit samples for each acoustical panel, for each exposed suspension system member, for each exposed molding and trim, and for each color and texture required, prepared on Samples of size indicated below. Samples shall show the full range of color and texture variations to be expected in the final installation.
 - 1. Acoustical Panel: Set of 6-inch (150-mm) square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch (300-mm) long Samples of each type, finish, and color.

1.3 INFORMATIONAL SUBMITTALS

- A. Embodied Carbon Reporting: Type III Environmental Product Declarations, per ISO 14025 disclosing the Global Warming Potential of the product from Stages A1 through A3 in accordance with Section 018133 "Sustainable Design Requirements - Embodied Carbon" for products listed under "Embodied Carbon Reporting" in Article "Quality Assurance."
- B. Embodied Carbon Submittals: Refer to Section 018133 "Sustainable Design Requirements - Embodied Carbon."
- C. Material Ingredient Disclosure: Submit one of the following reports for products listed under "Material Ingredient Disclosure" in Article "Quality Assurance."

1. Health Product Declaration.
2. UL Product Lens.
3. Living Building Challenge Declare Label or Living Product Challenge Label.
4. EPEA Material Health Statement.
5. Cradle-to-Cradle v4 Material Health Certificate or multi-attribute certificate.

D. Sustainability Reporting: Provide the following:

1. Recycled content, including pre-consumer and post-consumer percentages.
2. Biobased content for acoustical panels.
3. Manufacturing location.
4. End of Life:
 - a. Acoustical Ceiling Panels: Manufacturer Take-Back Program.
 - b. Suspension Systems and Trim: End-of-life recyclability percentage.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish and store at the site where directed, 2 percent of each type of acoustic panel and suspension system installed in the Project, packaged in manufacturer's unopened cartons and identified as to contents.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an Installer, with not less than 5 years experience in the installation of materials specified, and who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.
- C. Embodied Carbon Reporting: For the following product types, obtain products with Type III Environmental Product Declaration (EPD) in compliance with ISO 14025. Industry-wide EPDs must demonstrate that the manufacturer is a member of the publishing body responsible for the production of the EPD.
1. Acoustical Ceiling Panels: Product-Specific EPDs.
 2. Metal Suspension Systems: Product-specific or industry-wide EPDs.
 3. Metal Edge Moldings and Trim: Product-specific or industry-wide EPDs.
- D. Material Ingredient Disclosure: Obtain the following products with publicly available reports disclosing material ingredients to residuals no greater than 1000ppm:
1. Acoustical ceiling panels.
 2. Suspension systems, edge, and trim.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Performance Requirements: In areas where gypsum wallboard partitions are dependent on the ceiling suspension system for lateral support, design and install suspension system components to sustain the imposed load from the completed partition system including a minimum inward and outward pressure of 5 psf (239 Pa) normal to the plane of the wall.
- B. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
 - 1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance according to one of the following standards, or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - a. ASTM E 119 "Test Methods for Fire Tests of Building Construction and Materials."
 - b. Underwriters Laboratory (UL) "Fire Resistance Directory."
 - 2. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 3. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with one of the following:

- a. ASTM E 1264 "Standard Classification for Acoustical Ceiling Products" for Class A materials as determined by testing identical products per ASTM E 84 "Standard Test Method for Surface Burning Characteristics of Building Materials":
 - 1) Smoke-Developed Index: 450 or less.
- C. Sound Transmission Characteristics: For acoustical panel ceilings with STC ratings, provide materials and construction identical to those tested in assembly indicated according to the following standards:
 - 1. ASTM E 90 "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements."
 - a. Classified according to ASTM E 413 "Classification for Rating Sound Insulation" by a qualified independent testing agency.
- D. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 for the geographic location of the site.

2.2 METAL SUSPENSION SYSTEMS

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
- B. Hangers: As follows:
 - 1. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - a. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire but provide not less than 12 gage (0.106-inch) (2.69-mm) diameter wire.
 - 2. Flat Hangers: Commercial-sheet steel, ASTM A 653/A 653M, G60, hot dip galvanized.
 - a. Size: 1 by 3/16 inch (25.4 by 9.5 mm) by length indicated.
- C. Carrying Channels: ASTM C 754, cold rolled steel channels, 1-1/2-inch (38-mm), 475 pounds (215 kg) per 1000 feet (30.48 m).
- D. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners; provide in longest standard single piece lengths.

1. Shadow (Stepped Moldings): Stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member. Form from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.
 2. F Moldings: Provide F moldings at ceiling breaks, soffits, bulkheads, and changes in elevation other than vertical walls and columns to the extent indicated. Form from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.
 3. Metal Perimeter Channel Trim: Shapes and profiles to suit conditions indicated; fabricated from extruded aluminum; finished to match exposed flanges of suspension system runners. Provide manufacturer's recommended tee-bar connection clips, and hanging clips, which lock into specially designed bosses on the channel trim and are screw attached to the web of the intersecting suspension system members. Join sections of trim together with manufacturer's standard splice plates and alignment clips.
 4. Perimeter Wing Trim: Shapes and profiles to suit conditions indicated; fabricated from and finished to match exposed panel. Provide manufacturer's recommended connect wing cantilevers, connect splines, connect hooks, connect multi-connection, and installation screws suitable for installation indicated.
- E. Clips: Provide support clips, clamps, fasteners, splines, and other attachment devices as required to align components and to connect components and transfer imposed loads of suspension system.
1. Provide partition attachment clips, and fasteners for areas where partition ceiling runners are secured to the ceiling suspension system.
 2. Provide attachment clips for runner to angle molding to avoid use of pop rivets.
 3. Provide grid converter accessories as required to change main tee direction 90 degrees from adjacent main tee.
 4. Provide light fixture clips.
 5. Provide hold down clips at entryways to reduce flutter as required.
 6. Provide miter closure clips.
- F. Manufacturers and Products: Refer to drawings and schedules for extent and types of each metal suspension system required.
- 2.3 ACOUSTICAL PANELS (CL##)
- A. Manufacturers and Products: As indicated in the Finish Schedule on Drawings.
 - B. Maximum Embodied Carbon Limit for Acoustical Panel Ceilings: Maximum Global Warming Potential for Production Stages A1 through A3 as defined in Section 018133 "Sustainable Design Requirements - Embodied Carbon": 7.2 kg of CO₂eq per m².

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Layout the Work to center panel pattern in both directions around Work points shown in each major space or room as shown on the Drawings or directed and, where possible, adjust pattern so that edge pieces will be not less than 1/2 unit in width.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with manufacturer's written instructions, ASTM C636/C636M, and Cisca's "Ceiling Systems Handbook".
- B. Suspend ceiling hangers as follows:
 - 1. Fasten hangers to anchors that extend into decks. Space hangers not more than 48 inches (1200 mm) on center along each member supported directly from hangers; and provide hangers not more than 6 inches (150 mm) from ends of each member. Provide additional hangers for support of fixtures and other items including but not limited to light fixtures and diffusers, as required to prevent overloading of deck attachment, eccentric deflection or rotation of supporting runners.
 - 2. Hangers:
 - a. Secure wire hangers to ceiling suspension members and to supports above with a minimum of 3 tight turns. Connect hangers directly to drilled in anchors (eye screws), or other devices that are secure, and are appropriate for substrate.
 - b. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to drilled in anchors, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved.
 - 3. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

4. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of the supporting structure or of the ceiling suspension system.
 5. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Typical Edge Molding Attachment: Align moldings accurately and screw attach securely to substrate with concealed fasteners at intervals not more than 16 inches (400 mm) on center and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system. Miter corners accurately and connect securely.
 - a. Do not use exposed fasteners, including pop rivets, on moldings and trim.
 2. Window and Curtain Wall Frame Head Attachment: Unless otherwise indicated, align moldings accurately and secure to window and curtain wall frame heads using manufacturer's recommended double-sided foam white tape, leveling with ceiling suspension system. Miter corners accurately and adhere securely.
 - a. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- D. Install suspension system runners so they are square and securely interlocked with one another. Clip runners to angle moldings do not use exposed fasteners. Finish to lines and levels shown, with maximum deflection not to exceed 1/360 of the span between supports. Laser level accurately in all directions, leveling to a tolerance of 1/8-inch (3.18-mm) noncumulative. Remove and replace dented, bent, or kinked members.
- E. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Run grain of units in one direction as accepted on shop drawings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 2. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 3. For reveal-edged panels on suspension system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.
 4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using sealer and coating recommended in writing for this purpose by acoustical panel manufacturer.
 5. Install clean-room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Compliance of seismic design.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.
- C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.
 - 1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
 - a. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
 - b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- D. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 096513 - RESILIENT WALL BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes resilient wall base and accessories.

1.2 INFORMATIONAL SUBMITTALS

- A. Embodied Carbon Reporting: Type III Environmental Product Declarations, per ISO 14025 disclosing the Global Warming Potential of the product from Stages A1 through A3 in accordance with Section 018133 "Sustainable Design Requirements - Embodied Carbon" for products listed under "Embodied Carbon Reporting" in Article "Quality Assurance."
- B. Environmental Product Declaration (EPD) Disclosure Submittals: Completed Environmental Product Declaration Reporting Form in accordance with Section 010000 "General Requirements" for the following product types in this Section:
 - 1. Resilient Molding Accessories.
- C. TVOC Emissions: Laboratory test reports or third-party certificates showing compliance with the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers" version 1.2-2017 for products listed under "TVOC Emissions" in Article "Quality Assurance."
- D. Material Ingredient Disclosure: Submit one of the following reports for products listed under "Material Ingredient Disclosure" in Article "Quality Assurance."
 - 1. Health Product Declaration.
 - 2. UL Product Lens.
 - 3. Living Building Challenge Declare Label or Living Product Challenge Label.
 - 4. EPEA Material Health Statement.
 - 5. Cradle-to-Cradle v4 Material Health Certificate or multi-attribute certificate.
- E. Sustainability Reporting: Provide the following for resilient wall base and accessory products.
 - 1. Recycled content, including pre-consumer and post-consumer percentages.
 - 2. Biobased content.
 - 3. Manufacturing location.
 - 4. End of Life: Manufacturer Take-Back Program.

1.3 QUALITY ASSURANCE

- A. Embodied Carbon Reporting: Obtain the following products with the type of publicly available, third-party verified Type III Environmental Product Declaration (EPDs) listed below in accordance with Section 010000 "General Requirements."
 - 1. Resilient Wall Base: Product-specific Type III EPD.
- B. TVOC Emissions: Obtain the following products with publicly available reports or certificates verifying compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers" version 1.2-2017, following the private office scenario:
 - 1. Resilient Wall Base.
 - 2. Adhesive.
- C. Material Ingredient Disclosure: Obtain resilient wall base products with publicly available reports disclosing material ingredients to residuals no greater than 1000ppm.

1.4 FIELD CONDITIONS

- A. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT WALL BASE AND ACCESSORIES

- A. Resilient Wall Base: Refer to the Finish Schedule and the Drawings. Nominal thickness not less than 1/8 inch (3 mm) unless greater thickness is scheduled. All resilient base shall be manufactured from rubber complying with ASTM F 1861, Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic), Group I (solid, homogeneous). Provide all resilient wall base in continuous coils to minimize field butt joints. Provide all resilient wall bases with a coved base toe style typically and with straight flat or toeless base style at carpet, unless otherwise indicated on the Finish Schedule on the Drawings.
- B. Resilient Molding Accessories:
 - 1. Description: Reducer strip for resilient floor covering.
 - 2. Material: Rubber.
 - 3. Profile and Dimensions: As indicated on the Drawings.

- C. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Cove Base Adhesives: Not more than 50 g/L.
 - 2. Rubber Floor Adhesives: Not more than 60 g/L.

PART 3 - EXECUTION

3.1 PREPARATION AND INSTALLATION

- A. Prepare substrates and install products according to manufacturer's written recommendations.
- B. Wall Base: Comply with manufacturer's written instructions for installing resilient base.
 - 1. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
 - 2. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
 - 3. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
 - 4. Do not stretch wall base during installation.
- C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.
- D. Remove adhesive and other blemishes from exposed surfaces.

END OF SECTION

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes resilient tile flooring.

1.2 INFORMATIONAL SUBMITTALS

- A. Embodied Carbon Reporting: Type III Environmental Product Declarations, per ISO 14025 disclosing the Global Warming Potential of the product from Stages A1 through A3 in accordance with Section 010000 "General Requirements" for products listed under "Embodied Carbon Reporting" in Article "Quality Assurance."
- B. Environmental Product Declaration (EPD) Disclosure Submittals: Completed Environmental Product Declaration Reporting Form in accordance with Section 010000 "General Requirements" for the following product types in this Section:
 - 1. Trowelable Leveling and Patching Compounds.
- C. TVOC Emissions: Laboratory test reports or third-party certificates showing compliance with the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers" version 1.2-2017 for products listed under "TVOC Emissions" in Article "Quality Assurance."
- D. Material Ingredient Disclosure: Submit one of the following reports for products listed under "Material Ingredient Disclosure" in Article "Quality Assurance."
 - 1. Health Product Declaration.
 - 2. UL Product Lens.
 - 3. Living Building Challenge Declare Label or Living Product Challenge Label.
 - 4. EPEA Material Health Statement.
 - 5. Cradle-to-Cradle v4 Material Health Certificate or multi-attribute certificate.
- E. Sustainability Reporting: Provide the following for resilient tile products.
 - 1. Recycled content, including pre-consumer and post-consumer percentages.
 - 2. Biobased content.
 - 3. Manufacturing location.
 - 4. End of Life: Manufacturer Take-Back Program.

1.3 QUALITY ASSURANCE

- A. Embodied Carbon Reporting: Obtain the following products with the type of publicly available, third-party verified Type III Environmental Product Declaration (EPDs) listed below in accordance with Section 010000 "General Requirements."
 - 1. Luxury Vinyl Tile: Product-specific Type III EPD.
 - 2. Rubber Tile: Product-specific Type III EPD.
 - 3. Vinyl Composite Tile: Industry-wide or product-specific Type III EPD.
- B. TVOC Emissions: Obtain the following products with publicly available reports or certificates verifying compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers" version 1.2-2017, following the private office scenario:
 - 1. Resilient Tile.
 - 2. Adhesive.
- C. Material Ingredient Disclosure: Obtain resilient tile products with publicly available reports disclosing material ingredients to residuals no greater than 1000ppm.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Submit maintenance data for resilient floor tile and floor finish products.

1.5 FIELD CONDITIONS

- A. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT TILE FLOORING (RT##)

- A. Resilient Tile Products: Refer to Finish Schedule on Drawings.
- B. Embodied Carbon: Maximum Global Warming Potential for Production Stages A1 through A3 as defined in Section 010000 "General Requirements":
 - 1. Luxury Vinyl Tile: 20.5 kg of CO₂eq per m².

2.2 ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based formulation provided or approved by resilient product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
 - 1. VOC Content: Adhesives shall comply with the more stringent VOC content limits of Federal, State, or local authorities having jurisdiction, including California Air Resources Board (CARB), South Coast Air Quality Management District (SCAQMD) Rule 1168 (effective date January 1, 2023).
- C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION AND INSTALLATION

- A. Prepare concrete substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.
- B. Prepare concrete substrates according to ASTM F 710. Verify that substrates are dry and free of curing compounds, sealers, and hardeners. Perform alkalinity and adhesion tests recommended by manufacturer. Perform moisture tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
- C. Remove paint, sealers, substrate coatings, existing floor covering adhesive residues (if any), and other substances that are incompatible with adhesives using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- E. Apply primer to concrete slabs, if recommended by the flooring manufacturer, prior to application of adhesive.
- F. Comply with manufacturer's written instructions for installing floor tile.
- G. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- H. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

- I. Comply with manufacturer's written instructions for cleaning and protection of floor tile.
- J. Floor Polish for Resilient Tile Flooring: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish. If recommended by manufacturer, apply number of coats as recommended by manufacturer.
- K. Cover floor tile until Substantial Completion.

END OF SECTION

SECTION 096723 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resinous flooring.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each resinous floor system required and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Material certificates.
- B. Material test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Flammability: Self-extinguishing in accordance with ASTM D635.

2.2 RESINOUS FLOORING - FA1

- A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, resin-based monolithic floor surfacing designed to produce a seamless floor.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Arizona Polymer Flooring, Inc.
 - b. BASF Corporation.
 - c. CornerStone Flooring & Linings.
 - d. Crossfield Products Corp.
 - e. Crown Polymers, LLC.
 - f. Delta Polymers, Inc.
 - g. DUDICK Inc.
 - h. Duraflex, Inc.
 - i. FLEXMAR Coatings, Inc.
 - j. Florock Polymer Flooring.
 - k. Garland Company, Inc. (The).
 - l. Key Resin Company.
 - m. KOSTER American Corporation.
 - n. Laticrete International, Inc.
 - o. Milamar Coatings, LLC.
 - p. Neogard; a division of Jones-Blair, Inc.
 - q. Northern Industries, Inc.
 - r. Nox-Crete Products Group.
 - s. Pacific Polymers®; ITW Polymers Sealants North America.
 - t. Polymerica, Incorporated.
 - u. POLYSPEC THIOKOL®; ITW Polymers Sealants North America.
 - v. ROCK-TRED Corporation.
 - w. Sauereisen.
 - x. Sherwin-Williams Company, General Polymers.
 - y. Sika Corporation; Flooring.
 - z. Stonhard, Inc.
 - aa. Tamms; a brand of Euclid Chemical Company; an RPM Company.
 - bb. Tnemec Inc.
 - cc. Tufco International Inc.
- B. System Characteristics:
- 1. Color and Pattern: As selected by Architect from manufacturer's full range.
 - 2. Wearing Surface: Textured for slip resistance .
 - 3. Overall System Thickness: 1/16 inch (1.6 mm).
 - 4. Critical Radiant Flux: 0.22 W/sq. cm or greater in accordance with NFPA 253.
- C. Primer: Type recommended in writing by resinous flooring manufacturer for substrate and resinous flooring system indicated.

- D. Waterproofing Membrane: Type recommended in writing by resinous flooring manufacturer for substrate and resinous flooring system indicated.
- E. Reinforcing Membrane: Flexible resin formulation that is recommended in writing by resinous flooring manufacturer for substrate and resinous flooring system indicated and that inhibits substrate cracks from reflecting through resinous flooring.
- F. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended in writing by manufacturer for installation indicated.
- G. Body Coats:
 - 1. Resin: Epoxy .
 - 2. Formulation Description: 100 percent solids .
 - 3. Type: Pigmented.
 - 4. Installation Method: Self-leveling slurry with broadcast aggregates.
 - 5. Number of Coats: Two.
 - 6. Thickness of Coats: 1/16 inch (1.6 mm) .
 - 7. Aggregates: Manufacturer's standard .
- H. Grout Coat:
 - 1. Resin: Epoxy .
 - 2. Formulation Description: 100 percent solids .
 - 3. Type: Pigmented.
 - 4. Thickness of Coat: 1/16 inch (1.6 mm) 1/8 inch (3.2 mm) Insert thickness.
- I. Topcoats: Sealing or finish coats.
 - 1. Resin: Urethane .
 - 2. Formulation Description: 100 percent solids .
 - 3. Type: Clear.
 - 4. Number of Coats: One.
 - 5. Thickness of Coats: 8 mils (0.2 mm) .
 - 6. Finish: Gloss.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare and clean substrates in accordance with resinous flooring manufacturer's written instructions for substrate indicated to ensure adhesion.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
 - 1. Roughen concrete substrates as follows:

- a. Comply with requirements in SSPC-SP 13/NACE No. 6, with a Concrete Surface Profile of 3 or greater in accordance with ICRI Technical Guideline No. 310.2R, unless manufacturer's written instructions are more stringent.
 2. Repair damaged and deteriorated concrete in accordance with resinous flooring manufacturer's written instructions.
 3. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 4. Alkalinity and Adhesion Testing: Perform tests recommended in writing by resinous flooring manufacturer. Proceed with installation only after substrate alkalinity is not less than 6 or more than 8 pH unless otherwise recommended in writing by flooring manufacturer,
- C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates in accordance with manufacturer's written instructions.
1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring in accordance with manufacturer's written instructions.
- D. Resinous Materials: Mix components and prepare materials in accordance with resinous flooring manufacturer's written instructions.

3.2 INSTALLATION

- A. Apply components of resinous flooring system in accordance with manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness specified.
- B. Primer: Apply primer over prepared substrate at spreading rate recommended in writing by manufacturer.
- C. Waterproofing Membrane: Apply waterproofing membrane over entire substrate surface, in thickness recommended in writing by manufacturer.
- D. Reinforcing Membrane: Apply reinforcing membrane to entire substrate surface.
- E. Self-Leveling Body Coats: Apply self-leveling slurry body coats in thickness specified for flooring system.

1. Aggregates: Broadcast aggregates at rate recommended in writing by manufacturer. After resin is cured, remove excess aggregates to provide surface texture indicated.

- F. Troweled or Screeded Body Coats: Apply troweled or screeded body coats in thickness specified for flooring system. Hand or power trowel and grout to fill voids. When body coats are cured, remove trowel marks and roughness using method recommended in writing by manufacturer.

- G. Grout Coat: Apply grout coat to fill voids in surface of final body coat.

- H. Topcoats: Apply topcoats in number indicated for flooring system specified, at spreading rates recommended in writing by manufacturer, and to produce wearing surface specified.

- I. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes tile carpeting.

1.2 STANDARDS

- A. Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:
 - 1. The Carpet and Rug Institute "CRI 104 Commercial Carpet Installation Standard."
 - 2. The Carpet and Rug Institute "Green Label Plus" Standards.

1.3 INFORMATIONAL SUBMITTALS

- A. Embodied Carbon Reporting: Type III Environmental Product Declarations, per ISO 14025 disclosing the Global Warming Potential of the product from Stages A1 through A3 in accordance with Section 010000 "General Requirements for products listed under "Embodied Carbon Reporting" in Article "Quality Assurance."
- B. Environmental Product Declaration (EPD) Disclosure Submittals: Completed Environmental Product Declaration Reporting Form in accordance with Section 010000 "General Requirements" for the following product types in this Section:
 - 1. Trowelable Leveling and Patching Compounds.
- C. TVOC Emissions: Laboratory test reports or third-party certificates showing compliance with the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers" version 1.2-2017 for products listed under "TVOC Emissions" in Article "Quality Assurance."
- D. Material Ingredient Disclosure: Submit one of the following reports for products listed under "Material Ingredient Disclosure" in Article "Quality Assurance."
 - 1. Health Product Declaration.
 - 2. UL Product Lens.
 - 3. Living Building Challenge Declare Label or Living Product Challenge Label.
 - 4. EPEA Material Health Statement.
 - 5. Cradle-to-Cradle v4 Material Health Certificate or multi-attribute certificate.
- E. Sustainability Reporting: Provide the following for carpet products.

1. Recycled content, including pre-consumer and post-consumer percentages.
2. Biobased content for carpet tiles and cushions.
3. Manufacturing location.
4. End of Life: Manufacturer Take-Back Program.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Submit copies of instructions for care, cleaning, maintenance and repair of carpet tiles.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage a carpet installer, who has completed a minimum of three projects over the last 10 years which were similar in material, design and extent to that indicated for the Project - as determined by the Architect - and which have resulted in construction with a record of successful in service performance.
- B. Embodied Carbon Reporting: For the following product types, obtain products with Type III Environmental Product Declaration (EPD) in compliance with ISO 14025. Industry-wide EPDs must demonstrate that the manufacturer is a member of the publishing body responsible for the production of the EPD.
 1. Carpet Tile: Product-Specific EPDs.
- C. TVOC Emissions: Obtain the following products with publicly available reports or certificates verifying compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers" version 1.2-2017, following the private office scenario:
 1. Carpet tile.
 2. Carpet adhesives.
- D. Material Ingredient Disclosure: Obtain the following products with publicly available reports disclosing material ingredients to residuals no greater than 1000ppm:
 1. Carpet tile.
 2. Carpet adhesives.

1.6 FIELD CONDITIONS

- A. General: Comply with CRI 104, Section 7.0 "Site Conditions."
- B. Environmental Limitations: Do not deliver or install carpet tile until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during remainder of construction.

1.7 WARRANTY

- A. Special Carpet Manufacturer's Warranty: Written warranty, signed by carpet tile manufacturer agreeing to replace carpet tile that does not comply with requirements or that fails within 10 years from date of Substantial Completion. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, wear, static buildup in excess of 3.0 kV when tested under the Standard Shuffle Test at 70 deg F (21 deg C) and 20 percent RH, edge raveling without seam sealers, tuft bind loss, zippering (wet or dry), shrinkage, curling, doming, snags, runs, and delamination. Warrantees shall be full term, not pro-rated for the specified warranty period.
- B. Special Carpet Tile Installer's Warranty: Written warranty, signed by carpet tile installer agreeing to fix, repair or replace carpet tile that does not comply with requirements or that fails within 2 years from date of Substantial Completion. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than edge raveling, shrinkage, curling, doming, and delamination.

PART 2 - PRODUCTS

2.1 CARPET TILE (CP##)

- A. Carpet Tile Types: Provide manufacturer's commercial grade carpet tile for 100 percent glue-down installation as indicated in Finish Schedule on Drawings.
- B. Maximum Embodied Carbon Limit for Carpet Tile: Maximum Global Warming Potential for Production Stages A1 through A3 as defined in Section 010000 "General Requirements": 10.9 kg of CO₂eq per m².

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Portland cement-based formulation provided by or recommended by carpet tile manufacturer. Do not use gypsum based compounds.
- B. Adhesives: Water-resistant, mildew-resistant, and nonstaining, pressure sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for intended carpet tile, and recommended by manufacturer for releasable installation.
 - 1. VOC Content: Adhesives shall comply with the more stringent VOC content limits of Federal, State, or local authorities having jurisdiction, including California Air Resources Board (CARB), South Coast Air Quality Management District (SCAQMD) Rule 1168 (effective date January 1, 2023).

- C. Carpet Edging: Provide rubber composition carpet edging in single lengths wherever possible, keeping the number of joints or splices to a minimum. Provide in every location where carpet terminates and other flooring continues. Color to match adjacent carpet types.
- D. Floor Sealer: Type as recommended and manufactured by the carpet tile manufacturer for the applications indicated. Provide floor sealer with VOC content not more than 200 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Verify that concrete slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.

3.2 PREPARATION

- A. General: Comply with CRI 104, Section 8.0 "Substrate Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 10.0 "Carpet Tile Installation," carpet tile manufacturer's written installation instructions, and as required to match the accepted sample installations. Apply adhesive in accordance with adhesive manufacturer's directions.
- B. Adhere all full size, perimeter tiles, and cut tiles, with a full spread of adhesive. Dry fit cut tiles and apply adhesive to tile back after tile has been cut. Use full uncut tiles down the center of corridors and, where necessary, cut perimeter tiles to butt walls.
- C. Butt carpet tile tightly together to form seams without gaps or entrapped pile yarns and aligned with adjoining tiles.
- D. Install edge strip at every location where edge of carpet is exposed to traffic, unless otherwise indicated. Unless otherwise directed by Architect install in single lengths and secure in accordance with manufacturer's directions.

- E. Traffic over adhesive installations shall be restricted until adhesive has properly cured in accordance with the adhesive manufacturer's recommendations.
- F. As the carpeting is installed, remove and dispose of all trimmings, excess pieces of carpeting and laying materials from each area as it is completed. Vacuum carpeting with a commercial vacuum, having a cylindrical brush or beater bar and high suction. Remove adhesives, stains, and soil spots in accordance with the carpet manufacturer's recommendations.
- G. Protect installed carpet tile to comply with CRI 104, Section 11.0 "Post Installation," and against damage; damaged carpeting shall be rejected. Use non-staining cover material for protection. Tape joints of protective covering. Plastic and polyethylene sheet protective coverings shall not be permitted.
- H. Remove and replace rejected carpeting with new carpet tile. At the completion of the Work and when directed by the Architect, remove covering, vacuum clean carpeting and remove soiling and stains (if any) to the satisfaction of the Architect.

END OF SECTION

SECTION 096819 - INTERIOR SYNTHETIC TURF

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes interior synthetic turf.
- B. Related Requirements:
 - 1. Section 035416 "Hydraulic Cement Underlayment" for patching and leveling of substrates.

1.2 PRE-INSTALLATION MEETINGS

- A. Pre-Installation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to turf installation including, but not limited to, the following:
 - a. Review delivery, storage, and handling procedures.
 - b. Review ambient conditions and ventilation procedures.
 - c. Review subfloor preparation procedures.

1.3 ACTION SUBMITTALS

- A. Product Data: Submit product data, specifications, installation instructions for materials specified herein and other data as may be required to show compliance with the Contract Documents. Include installation recommendations for each type of substrate required.
- B. Shop Drawings: Submit shop drawings showing the following:
 - 1. Seam locations and direction, types, and methods.
 - 2. Type of subfloor.
 - 3. Type of installation.
 - 4. Include on shop drawings dimensions which verify field conditions.
 - 5. Transition, and other accessory strips.
 - 6. Transition details to other flooring materials.

1.4 INFORMATIONAL SUBMITTALS

- A. Embodied Carbon Submittals: Refer to Section 018133 "Sustainable Design Requirements - Embodied Carbon."

1. Completed Environmental Product Declaration Reporting Form for each principal product type in this Section.
 2. For products with completed Environmental Product Declaration Reporting Forms claiming availability of an applicable EPD, provide the Product-Specific or Industry-Wide Type III Environmental Product Declaration (EPD) in compliance with ISO 14025.
 3. The Contractor is advised that the submission of the embodied carbon EPD materials to the USGBC is not required.
- B. Field Test Reports: Provide signed field test reports for tests indicated below. Indicate results and test locations. Include manufacturer's recommendations.
1. Anhydrous calcium chloride test results.
 2. Relative humidity probe test results.
 3. Alkalinity test results.
- C. Warranties: Submit special warranties specified in this Section.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Submit copies of instructions for care, cleaning, maintenance and repair of interior synthetic turf.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Engage a turf installer, who has completed a minimum of three projects over the last 10 years which were similar in material, design and extent to that indicated for the Project - as determined by the Architect - and which have resulted in construction with a record of successful in service performance.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect synthetic turf rolls and accessories from damage during delivery and store in a dry area or elevate above ground, under an impermeable tarp when time from delivery to installation exceeds one week.
- B. Deliver other materials in manufacturer's unopened containers identified with name, brand, type, grade, class, and other qualifying information.
- C. Store materials in a dry location, at temperature and humidity conditions recommended by manufacturer, in such a manner as to prevent damage.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install turf until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Do not install turf over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and concrete slabs have pH range recommended by turf manufacturer.
- C. Temperature Requirements: Maintain air temperature in spaces where products will be installed for time period before, during, and after installation as recommended by manufacturer.
- D. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

1.9 WARRANTY

- A. Special Manufacturer's Warranty: Written warranty, signed by turf manufacturer agreeing to replace turf that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of turf due to unusual traffic, failure of substrate, vandalism, or abuse. Warrantees shall be full term, not pro-rated for the specified warranty period.
 - 1. Warranty Period: 15 years from date of Substantial Completion.
- B. Installation Warranty: Submit copies of written warranty signed by the turf installer and Contractor, warranting the turf installation, for a period of two years, that turf will not tear, crack, separate, deteriorate or pull loose from substrate, or experience seam failure, ripples, scallops, pilling or puckering.

PART 2 - PRODUCTS

2.1 INTERIOR SYNTHETIC TURF

- A. Basis of Design Product: Subject to compliance with requirements, provide K9Grass Classic+ Airgrid 3 manufactured by Forever Lawn.
- B. Product Characteristics: Interior synthetic turf (roll goods), 7/8 inch pile height (knitted).
 - 1. Fiber Type: Nylon monofilament.
 - 2. Construction type: Knitted

3. Blase Height: 1-1/4"
4. Total Fabric Weight: 65 oz
5. Backing: Flow-through
6. Antimicrobial: AlphaSan

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Portland cement based formulation provided by or recommended by the manufacturer. Do not use gypsum based compounds.
- B. Adhesives: Water-resistant, mildew resistant, and nonstaining, high solids, low VOC emitting formulations that are specifically recommended by the turf manufacturer, as verified through compatibility and adhesion testing for the intended substrate and application, and that comply with flammability requirements for installed turf:
- C. Seaming Tape: Hot melt adhesive tape, 6 inches (152 mm) wide, recommended by the turf manufacturer as suitable for backing specified.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for substrate conditions, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected. Commencement of work constitutes installer's acceptance of substrate.

3.2 PREPARATION

- A. General: Comply with turf manufacturer's written installation instructions for preparing substrates.
- B. Coordinate the installation of turf so as not to delay the occupancy of the site or interfere with the completion of construction.
- C. Examine the substrates, adjoining construction and the conditions under which the Work is to be installed. Verify recommended limits for moisture content and alkalinity of concrete substrates with turf manufacturer.
 1. Moisture Content: Verify moisture content using a standard calcium chloride crystal test or a 1 square yard (0.84 sq.m) clear plastic test. Perform testing at a frequency of not less than once every 1,000 square feet (93 sq.m).

2. Alkalinity Test: Verify alkalinity of concrete substrates by drilling a 3/8 inch (9.5 mm) diameter hole approximately 1/4 inch (6.35 mm) deep, remove all residue; fill with distilled water, allow water to stand 3 minutes and test with a calibrated electronic meter or pH paper. Perform testing at a frequency of not less than once every 1,000 square feet (93 sq. m).
 3. Alternative test procedures for moisture content and alkalinity may be acceptable subject to the turf manufacturer's review and written acceptance.
- D. Concrete Subfloors: Verify that concrete slabs comply with the following:
1. Provide one of the following:
 - a. Remove coatings, including curing compounds, existing floor covering adhesive residues, 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 the turf manufacturer.
 - b. In lieu of mechanical substrate preparation methods the Contractor may utilize floor sealer materials and methods of the types and methods as recommended, in writing, by the turf manufacturer. Apply sealer in number of coats, and at the spread rate, as required by the turf manufacturer.
 2. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by the turf manufacturer.
 3. Use leveling and patching compounds recommended by flooring manufacturer for filling cracks, holes and depressions in the substrate. Surface shall be smooth, level and at proper elevation. Remove ridges, roughness and protrusions from concrete surfaces by grinding.
- E. Broom and vacuum clean substrates to be covered immediately before installing turf.
- F. Installation shall not commence until painting and finishing work are complete and ceiling and overhead work is tested, approved, and completed.
- G. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.3 INSTALLATION
- A. General: Comply with manufacturer's written installation guidelines and as follows:
1. Lay turf so that grain runs in one direction and against the slope. Replace and discard turf that has obvious defects.
 2. Make turf seams in accordance with the turf manufacturer's instructions. Seams shall be invisible after completion of installation. Seaming must be done in a manner to ensure no trip hazards.

- a. Where seaming is required (multiple roll widths), trim the selvage (un-tufted edge) off of one roll and lay it on the base, in the desired position.
 - b. Lay the next roll adjacent to the first and overlap one edge of the adjacent roll of turf on top of the trimmed edge of the first roll.
 - c. With scissors or razor knife, trim the overlapped roll to match the trimmed edge of the first roll.
 - d. Make all cuts as close as possible without touching.
 - e. Repeat as needed for as many roll widths as the job requires.
 - f. Around the borders, trim the turf to match the edges.
 - g. Fold the adjacent trimmed edges of two rolls of turf approximately two feet apart the entire length of the seam.
 - h. Mark the centerline of the seam on the exposed base with a chalk line or spray paint.
 - i. Roll out seam tape centered over the entire length of the seam line. Apply adhesive covering all of the seam tape from one end to the other. Depending on the type of adhesive used, you may need to allow time for vapors/gases to escape (flashing). Refer to the adhesive manufacturer's directions. The flashing time required may be dependent on ambient temperature and humidity.
 - j. After adhesive has flashed, lay the edges of each roll of turf directly onto the adhesive/tape, making sure not to bury any grass fibers into the adhesive.
 - k. Be sure to add weight (i.e. sandbags) down the length of the freshly laid seam, or use a heavy roller along the seam length. The adhesive drying / curing time will vary with different adhesives dependent upon climatic conditions.
 - l. Follow the adhesive manufacturer's instructions.
3. Secure edges of turf after the main body of the turf area has been stabilized, the perimeter edges should be secured in a manner to avoid trip hazard, edge fray, etc.

3.4 CLEANING AND PROTECTION

- A. **Cleaning:** As the turf is installed, remove and dispose of all trimmings, excess pieces of turf and laying materials from each area as it is completed. Remove adhesives, stains, and soil spots in accordance with the turf manufacturer's recommendations.
- B. **Protection:** Protect turf against damage of every kind as damaged turf shall be rejected. Use non-staining cover material for protection. Tape joints of protective covering.
 1. Plastic and polyethylene sheet protective coverings shall not be permitted unless specifically accepted in writing by the turf manufacturer.
 2. Remove and replace rejected turf with new turf. At the completion of the work and when directed by the Architect, remove covering, vacuum clean turf and remove soiling and stains (if any) to the satisfaction of the Architect.

Gensler
003.8017.012

May 07, 2026
Issue for Pricing & Permit

**GJT Level 2 Amenities and Elevator
Modernization**
Grand Junction, Colorado

END OF SECTION

SECTION 097700 - SOLID PHENOLIC WALL PANELING

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide High pressure laminate (HPL) compact panels for interior architectural wall lining application.
- B. Related Sections: Coordinate with Work of other sections including the following:
 - 1. Section 064023 - Interior Architectural Woodwork
 - 2. Section 079200 - Joint Sealants
 - 3. Section 092900 - Gypsum Board
 - 4. Section 099000 - Painting

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include Manufacturer's written literature including product characteristics, technical data, performance values and available colors and thicknesses. Submit Manufacturer's written recommendations for evaluating, preparing and treating substrate and attachment to substrate and installation technique brochure.
- B. Shop Drawings: Show fabrication and installation layouts of HPL Compact Interior wall panels, details of attachment and wall structure conditions, anchorages for support structure, attachment system for panels, allowances for thermal expansion, trim, closures, corner conditions, and accessories as required or specified by the architect.
- C. Samples: For each type of finish required, provide samples of size and type indicated below for approval:
 - 1. Wall panels: Minimum of 4" x 4" or manufacturer standard sample size per color specified
 - 2. Substructure: as specified by architect provide z clip, closures, corner profiles or other required fasteners and substructure to achieve the design intent by architect
- D. Installer Qualification Data: For installer, provide certification or letter signed by Manufacturer certifying the installer complies with requirements to perform the work specified in this section.
- E. Closeout Submittals: From HPL Compact Interior manufacturer provide the following:
 - 1. Operation and Maintenance data: operation, cleaning and maintenance manuals or brochures including methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.

2. FSC Chain of Custody Certificate.
 3. Environmental Product Declaration (EPD) Report
 4. Health Product Declaration (HPD)
 5. SEFA 8 independent test cert
 6. Greenguard certification
- F. Warranty: Provide Manufacturer's standard warranty for HPL Compact interior panel products against defects in manufacturing.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in the installation of interior HPL Compact wall panel systems who has a minimum of 2 years installing products indicated in this Project, whose work has resulted in applications with a record of successful in-service performance, and who is recognized and approved by the manufacturer as suitable for the execution of the Work.
- B. Fabricator Qualifications: A shop that employs skilled workers who custom fabricate HPL Compact or similar wall panel systems to those required for this Project and whose finished products have a record of successful in-service performance and who is approved by the manufacturer. If shop drawings are required for the Project the shop drawings are to be drawn and coordinated by the approved fabrication company.
- C. Source Limitations: Obtain HPL Compact Interior and all auxiliary materials from a single source Manufacturer who has a minimum of 35 years of experience in the manufacturing of high pressure HPL Compact or an accessory Manufacturer certified by the HPL Compact Interior panel Manufacturer. Panels to be manufactured in accordance to ISO9001, ISO14001 and EN 438-4
- D. Pre-Installation Conference: Conduct pre-installation conference at Project site prior to commencing construction of mock-up specified herein to verify Project requirements.
1. Review wall lining installation requirements including substrate surface preparation, environmental or site limitations, typical details including attachment and trims, Manufacturer's recommended installation procedures, coordination with adjacent trades, inspection procedures (if any), protection of work and repair procedures.
 2. Insure all sub-trades interfacing with or affected by the construction of the wall lining are present, including Architect, General Contractor, HPL Compact Manufacturer's Representative, and any other installer whose work interfaces with the HPL Compact wall panels.
- E. PROJECT CONDITIONS, STORAGE AND HANDLING
1. Proceed with installation only when existing conditions permit assembly of the wall lining as performed to the Manufacturer's written installation instructions and warranty requirements.
 2. Field Measurements: Verify actual panel measurements / openings by field measurement before fabrication to accommodate site tolerances and changes in construction.

3. Comply with Manufacturer's stated ordering, lead-time and manufacturing requirements to avoid construction delays.
4. Comply with Manufacturers written material handling and storage guidelines. Do not store panels in such a way that might cause damage by other trades, staining, scratching or other surface damage.
5. HPL Compact Interior installer shall notify General Contractor or Construction Manager immediately upon discovery of any issues with the substrate, i.e. improper framing, walls out of plumb or other conditions affecting proper on plane installation. These issues shall be appropriately addressed prior to continuation of panel system installation.
6. Remove damage and waste panel material from site and legally dispose of according to project guidelines or authority having jurisdiction.

F. WARRANTY

- G. Manufacturer's standard 2 year limited warranty covering defects in material or manufacturing quality. Panel to be warranted against delamination for 2 years.
- H. Warranty is only available when HPL Compact panels are installed and fabricated by an installation contractor that has been approved by the Manufacturer and has followed the recommended guidelines of the Manufacturer, and has been signed and dated by the appropriate parties listed on the warranty registration form.
- I. Submittal of Warranty must be made within 6 months of substantial completion of the Project. Contact Manufacturer for warranty submittal procedure.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. These specifications are based on Fundermax Max Compact Interior High Pressure Laminate (HPL) wall panels manufactured by Fundermax GmbH, Fundermax North America, 9401-P Southern Pine Boulevard Charlotte, NC 28273. Telephone: (980) 299-0035. A list of local fabricators or installers that provide products complying with this specification section may be requested from the above address.
 1. Basis of Design: Fundermax Max Compact Interior F Quality for interior application
 2. Alternate Products:
 - a. Max Compact IP F-quality
 3. Substitutions for alternate products can be made providing they meet or exceed BOD and are approved by the architect ten days prior to bid submittals.
- B. Product Description:

1. HPL Compact Interior consists of multiple layers of cellulose fibrous material impregnated with thermosetting resins and decorative surface layers bonded together in a high heat and pressure process, defined as the simultaneous application of heat (>120 degrees C) and high specific pressure (>5 MPa) providing for flow and subsequent curing of the thermosetting resins resulting in a homogenous, non-porous material. The thermosetting resins are irreversibly cross-linked by chemical bonds during the curing process producing a non-reactive and stable material. The HPL Compact Interior comprises a minimum of 60% recycled content
2. Acceptable alternate products must be manufactured using a high pressure laminate press process in accordance with EN 438-4 and may not be manufactured as a low pressure lamination to a phenolic core.
3. Panel Decor: select as appropriate (Unicolours) or (Nature) or (Material) or (Metallic)
4. Color number 4073, Newport Oak
5. Panel Surface: FH
6. Panel Core: Brown Color Through Core
7. Panel Thickness: (10mm)
8. Panel Module for finished installation: Refer to architectural drawings

2.2 SOURCE QUALITY CONTROL:

- A. Panels shall be of a HPL Compact specifically designed for wall cladding applications. Fabricated panels shall comply with all current codes and regulations for the Project. Panels shall have uniform thickness (+0.03") and flatness (maximum difference of 0.03") for a 10 foot span.
1. Flame Spread: Panels to conform to ASTM E-84 for Class A fire rating with a Flame spread index of less than 25 and Smoke development index of less than 450.
 2. Panels must comply with the European standard EN 438-4 as high pressure compact laminate (HPL).
 3. Performance Requirements:
 - a. Weight: 6mm, 1.8 lbs./SF; 8mm 2.4 lbs./SF; 10mm, 3 lbs./SF; 13mm, 3.9 lbs./SF
 - b. Tensile Strength: 11,000-PSI, minimum.
 - c. Flexural Strength: 13,000-PSI, minimum.
 - d. Surface Impact Resistance: ≤ 8 per EN 438:2:21
 - e. Scratch Resistance: $\geq 3/4$ N per EN 438:2:25
 - f. Resistance Against Stress Abrasion: ≥ 150 U per EN 438-2-10
 - g. Optical Properties: Color Stability Gray Scale ≥ 4 per EN 438:2:27
 - h. SEFA 8PH-2014, 8.1 - Pass rate with zero level 3 conditions
- B. Panel Tolerance:
1. Thickness: 1/32" maximum.
 2. Length: 1/4" maximum.
 3. Width: 1/4" maximum.

2.3 SUB-FRAME ASSEMBLY

- A. Aluminum z-clips as approved by Manufacturer and according to Manufacturer technical guidelines and must be designed to handle the weight per square foot of the specified panel
- B. Glue-fix adhesive system as approved by Manufacturer and according to Manufacturer technical guidelines.
- C. Allow manufacturer minimum clear air space of $\frac{3}{4}$ " behind vertical attached sub-structure for ventilation of panels to prevent condensation accumulation behind wall panels
- D. Wall Lining System by a recognized wall lining system supplier (fill in specified system here)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install vertical sub-frame for ventilation in accordance to shop drawings. A minimum $\frac{3}{4}$ " free air space should be created regardless of mounting sub-structure selected.
- B. Install Fundermax HPL Compact Interior wall panels according to shop drawings and specification.
- C. Maximum fastening (fixing) distances for panels is dependent on mechanical or adhesive fastening system and the Fundermax Interior Technique Brochure should be referenced on pages 40 -52.
- D. If a z-clip system is to be used the panel clip is to be true and plumb.
- E. Installed panels shall have horizontal and vertical joints of equal dimension. 8mm joints are the recommended joint width subject to design of panel module. Exact dimension of joint may vary depending on wall panel size. The joint allows for controlled expansion and contraction of panels.
- F. Corner conditions are to be per architectural specification and drawings.

3.2 PROTECTION

- A. After installation the General Contractor shall protect the panels from damage from other trades until the facility is opened. The panels shall be kept free from paint, plaster, cement scratches, or any other destructive forces.

3.3 CLEANING

- A. Panels are to be cleaned per Manufacturer's recommended practices using non-abrasive cleaners. Refer to the Cleaning and Chemical Resistance of Fundermax HPL Compact Panels in the close-out package for maintenance and cleaning instructions.

END OF SECTION

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and field application of primers to exposed interior surfaces of the following substrates:
 - 1. Concrete wall surfaces, wood and hardboard, and ferrous and zinc-coated (galvanized) steel.
- B. Related Section: Refer to Section 099123.16 "Interior Latex Painting" for traditional latex interior paint systems.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat, with texture to simulate actual conditions.
 - 1. Provide stepped Samples, defining each separate coat, including primers. Use representative colors when preparing Samples for review. Resubmit until required gloss, color, and texture are achieved.
 - 2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
 - 3. Submit paint samples on actual substrate to be painted, 12 inches square of each color and texture required.

1.3 INFORMATIONAL SUBMITTALS

- A. Environmental Product Declaration (EPD) Disclosure Submittals: Completed Environmental Product Declaration Reporting Form in accordance with Section 010000 "General Requirements" for the following product types in this Section:
 - 1. Wood-Knot Sealer.
 - 2. Primers:
 - a. Alkali Resistant, Water Based.
 - b. Latex, for Interior Wood.
 - c. Acrylic.
- B. VOC Content: Product data or laboratory reports showing compliance with VOC content limits.

1.4 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore Family of Products (Benjamin Moore, Coronado, Corotech, Insl-x, LenMar)
 - 2. Dunn-Edwards Corporation (Dunn-Edwards).
 - 3. PPG Paints (PPG)
 - 4. Sherwin-Williams Co. (SW)
 - 5. Vista Paint Corporation (Vista)

2.2 PAINT, GENERAL (PT##)

- A. Material Compatibility: Provide materials for use within each paint system that are compatible with one another and with the substrates indicated, under conditions of service and application, as demonstrated by manufacturer based on testing and field experience. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. VOC Content: Products shall comply with the more stringent VOC content limits of Federal, State, or local authorities having jurisdiction.
- C. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

2.3 PREPARATORY COATS

- A. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.
- B. Primer Sealer, Latex, Interior: Refer to Section 099123.16 "Interior Latex Painting."
- C. Primer, Alkali Resistant, Water Based:
 - 1. Benjamin Moore; Super Spec Masonry Int/Ext Acrylic High Build Primer (N068).
 - 2. Dunn-Edwards; Eff-Stop Premium Interior/Exterior Masonry Primer/Sealer (ESPR00).
 - 3. PPG; Perma-Crete Interior/Exterior Alkali-Resistant Primer (4-603).
- D. Primer, Latex, for Interior Wood:
 - 1. Benjamin Moore; Ultra Spec 500 Interior Latex Primer (N534).
 - 2. PPG; SEAL GRIP Interior Primer/Finish (17-951).
 - 3. SW; Premium Wall & Wood Interior Latex Primer (B28W08111).
- E. Primer, Acrylic:
 - 1. Benjamin Moore; Super Spec HP Acrylic Metal Primer (P04).
 - 2. SW; Pro Industrial Pro-Cryl Universal Primer (B66-310 Series).
- F. Where manufacturer does not recommend a separate primer formulation on substrate indicated, use paint specified for finish coat.

2.4 WATER BASED FINISH COATS

- A. Latex, Interior, Gloss Level 1 (Flat): Refer to Section 099123.16 "Interior Latex Painting."
- B. Latex, Interior, Gloss Level 3 (Eggshell). Refer to Section 099123.16 "Interior Latex Painting."
- C. Latex, Interior, Gloss Level 5 (Semigloss): Refer to Section 099123.16 "Interior Latex Painting."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove hardware and hardware accessories, cover plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible, provide surface-applied protection before surface preparation and painting.
- B. Before applying paint or other surface treatments, clean substrates of substances that could impair bond of paints. Remove oil and grease before cleaning.
 - 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each substrate condition and as specified. Provide barrier coats over incompatible primers or remove and reprime.
 - 1. Concrete Substrates: Remove release agents, curing compounds, hardeners, sealers, efflorescence, dust, dirt, grease, oils and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
 - 2. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances in accordance with SSPC SP 1 for Solvent Cleaning. After solvent cleaning prepare any bare metal surfaces by removing all stratified rust (rust scale), all loose mill scale, all loose or non-adherent rust and detrimental welding deposits by methods specified in SSPC SP-3 for "Power Tool Cleaning."
 - a. Touch up bare areas, heads of bolts, welded surfaces which are unpainted, and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
 - 3. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents in accordance with SSPC SP-1 for "Solvent Cleaning" and pretreat in accordance with the recommendations of SSPC Good Painting Practice, Vol. 1, Chapter 22.

4. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - b. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.

3.2 APPLICATION

- A. Refer to Section 099123.16 "Interior Latex Painting."
- B. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

3.3 INTERIOR PAINTING SCHEDULE

- A. Concrete: Provide primers as specified in Part 2 of this Section. Refer to Section 099123.16 "Interior Latex Painting" for finish coats.
- B. Wood and Hardboard Substrates: Provide knot sealers and primers as specified in Part 2 of this Section. Refer to Section 099123.16 "Interior Latex Painting" for finish coats.
- C. Steel Substrates: Provide primers as specified in Part 2 of this Section. Refer to Section 099123.16 "Interior Latex Painting" for finish coats.
- D. Galvanized Metal Substrates: Provide primers as specified in Part 2 of this Section. Refer to Section 099123.16 "Interior Latex Painting" for finish coats.

END OF SECTION

SECTION 099123.16 - INTERIOR LATEX PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and field application of traditional interior latex paint systems to exposed interior items and surfaces.
- B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted. If an item or a surface is not specifically mentioned, paint the item, or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

1.2 DEFINITIONS

- A. General: The following terms apply to this Section. Gloss level shall be determined according to ASTM D 523.
 - 1. Gloss Level 1(Flat, or Matte): Not more than 5 units at 60 degrees and 10 units at 85 degrees.
 - 2. Gloss Level 3 (Eggshell): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees.
 - 3. Gloss Level 4 (Satin or Low Luster): 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees.
 - 4. Gloss Level 5 (Semigloss): 35 to 70 units at 60 degrees.

1.3 ACTION SUBMITTALS

- A. Samples for Verification: For each type of paint system and in each color and gloss of topcoat, with texture to simulate actual conditions.
 - 1. Provide stepped Samples, defining each separate coat, including primers. Use representative colors when preparing Samples for review. Resubmit until required gloss, color, and texture are achieved.
 - 2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
 - 3. Submit paint samples on actual substrate to be painted, 12 inches (305 mm) square of each color and texture required.

1.4 INFORMATIONAL SUBMITTALS

- A. VOC Content: Product data or laboratory reports showing compliance with VOC content limits.
- B. TVOC Emissions: Laboratory test reports or third-party certificates showing compliance with the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers" version 1.2-2017.
- C. Material Ingredient Disclosure: Submit one of the following reports:
 - 1. Health Product Declaration.
 - 2. UL Product Lens.
 - 3. Living Building Challenge Declare Label or Living Product Challenge Label.
 - 4. EPEA Material Health Statement.
 - 5. Cradle-to-Cradle v4 Material Health Certificate or multi-attribute certificate.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. TVOC Emissions: Obtain latex paint and primer products with publicly available reports or certificates verifying compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers" version 1.2-2017, following the private office scenario.
- C. Material Ingredient Disclosure: Obtain latex paint and primer products with publicly available reports disclosing material ingredients to residuals no greater than 1000ppm.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore Family of Products (Benjamin Moore, Coronado, Corotech, Insl-x, LenMar)
 - 2. Dunn-Edwards Corporation (Dunn-Edwards).
 - 3. PPG Paints (PPG)
 - 4. Sherwin-Williams Co. (SW)

5. Vista Paint Corporation (Vista)

2.2 PAINT, GENERAL (PT##)

- A. Material Compatibility: Provide materials for use within each paint system that are compatible with one another and with the substrates indicated, under conditions of service and application, as demonstrated by manufacturer based on testing and field experience. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. VOC Content: Interior latex paints and primers shall comply with the more stringent VOC content limits of Federal, State, or local authorities having jurisdiction, including California Air Resources Board (CARB), South Coast air Quality Management District Rule 1113 (effective date January 1, 2019).
- C. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- D. Colors and Gloss: As indicated in Finish Schedule on Drawings. Reference to a particular manufacturer's number or color name is used only as a convenience for the Architect to establish the Project color and gloss requirements. These references are not intended to describe the required generic paint systems. For generic paint system requirements, refer to the "Interior Paint Schedule" at the end of Part 3, as applicable to the respective conditions of use.
 - 1. The selection of paint colors and gloss are indicated by manufacturer and color type; designated as "PT##."
 - 2. Furnish the same lots, batches, etc. within the same contiguous areas of the building (i.e., corridors on the same floors, common rooms which adjoin each other, etc.).

2.3 PREPARATORY COATS

- A. Primer Sealer, Latex, Interior:
 - 1. Benjamin Moore; Ultra Spec 500 Interior Latex Primer (N534).
 - 2. PPG; Speedhide Zero Interior Latex Sealer Quick-Drying (6-4900).
 - 3. SW; ProMar 200 Zero VOC Interior Latex Primer (B28W02600).
- B. Primer, Alkali Resistant, Water Based: Refer to Section 099123 "Interior Painting."

- C. Primer, Latex, for Interior Wood: Refer to Section 099123 "Interior Painting."
- D. Primer, Acrylic: Refer to Section 099123 "Interior Painting."
- E. Where manufacturer does not recommend a separate primer formulation on substrate indicated, use paint specified for finish coat.

2.4 INTERIOR LATEX PAINT FINISH COATS

- A. Latex, Interior, Gloss Level 1 (Flat): Factory-formulated flat acrylic-emulsion latex paint for interior application.
 - 1. Benjamin Moore; Ultra Spec 500 Interior Flat (N536).
 - 2. Dunn-Edwards; SpartaZero Zero VOC Interior Latex Flat (SZRO10)
 - 3. PPG; SPEEDHIDE zero Interior Zero-VOC Latex Flat (6-4110XI).
 - 4. SW; ProMar 200 Zero VOC Interior Latex Flat (B30-2600 Series).
- B. Interior Flat Latex-Emulsion Size: Factory-formulated flat latex-based interior paint.
 - 1. Benjamin Moore; Ultra Spec 500 (536) Interior Flat Finish: Applied at a dry film thickness of not less than 1.3 mils (33 microns).
 - 2. PPG Paints; PPG SPEEDHIDE zero VOC Latex Flat 6-4110 Series: Applied at a dry film thickness of not less than 1.3 mils (33 microns).
 - 3. Sherwin-Williams; ProMar 200 Zero VOC Flat B30-2600 Series: Applied at a dry film thickness of not less than 1.5 mils (38 microns).
- C. Latex, Interior, Gloss Level 3 (Eggshell). Factory-formulated eggshell acrylic-latex interior enamel.
 - 1. Benjamin Moore; Ultra Spec 500 Interior Eggshell (N538).
 - 2. PPG; SPEEDHIDE zero Interior Zero-VOC Latex Eggshell (6-4310XI).
 - 3. SW; ProMar 200 Zero Interior VOC Latex Eg-Shel (B20-2600 Series).
- D. Latex, Interior, Gloss Level 5 (Semigloss): Factory-formulated semigloss acrylic-latex enamel for interior application.
 - 1. Benjamin Moore; Ultra Spec 500 Interior Semi-Gloss (N539).
 - 2. PPG; SPEEDHIDE zero Interior Zero-VOC Latex Semi-Gloss (6-4510XI).
 - 3. SW; ProMar 200 Zero VOC Latex Semi-Gloss (B31-2600 Series).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with manufacturer's requirements for paint application. Comply with procedures specified in PDCA P4.

1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.

3.2 PREPARATION

- A. Remove hardware and hardware accessories, cover plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible, provide surface-applied protection before surface preparation and painting.
- B. Before applying paint or other surface treatments, clean substrates of substances that could impair bond of paints. Remove oil and grease before cleaning.
 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each substrate condition and as specified. Provide barrier coats over incompatible primers or remove and reprime.
 1. Gypsum Wallboard: Repair all surfaces in gypsum wallboard with wallboard joint finishing compound or spackling compound, filled out flush and sanded smooth. Clean all surfaces and taped joints of dust, dirt and other contaminants and be sure they are thoroughly dry before applying paint.
 2. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.
- D. Mix and prepare paint materials according to manufacturer's written instructions.
 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- E. Tinting: Tint each undercoat a lighter shade to facilitate identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the topcoat but provide sufficient difference in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in Finish Schedule on Drawings.
 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 3. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 4. Provide finish coats that are compatible with primers used.
 5. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convactor covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 6. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 7. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 8. Paint back sides of access panels and removable or hinged covers to match exposed surfaces. Access panels, electrical panels, air diffusing outlets, supply and exhaust grilles, louvers, exposed conduit, primed hardware items, primed outlet covers, primed wall and ceiling plates and other items in painted areas shall be painted to match the areas in which they occur unless otherwise directed by the Architect.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 - a. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
 - b. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
 - c. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 2. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

- C. Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
 - 1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 - 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 - 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- F. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in occupied spaces.
 - 1. Mechanical items to be painted include, but are not limited to, the following:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Tanks that do not have factory-applied final finishes.
 - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - f. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 - 2. Electrical items to be painted include, but are not limited to, the following:
 - a. Conduits and fittings.
 - b. Switchgear.
 - c. Panelboards.
 - d. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- G. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

- H. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- I. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- J. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 MARKING AND IDENTIFICATION

- A. Mark fire-rated and smoke-rated partitions required to have protective openings or penetrations.
 - 1. Locate markings in accessible concealed floor, floor-ceiling, or attic spaces.
 - 2. Provide markings within 15 feet (4572 mm) of the end of each wall and at intervals not exceeding 30 feet (9144 mm) measured horizontally along the partition.
 - 3. Marking shall include stenciled lettering not less than 3 inches (76 mm) in height with a minimum 3/8-inch (9.5 mm) stroke.
 - 4. Apply markings in a contrasting color with the suggested wording "FIRE AND/OR SMOKE BARRIER---PROTECT ALL OPENINGS", or other wording as approved by the Authority Having Jurisdiction.

3.5 CLEANING

- A. At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
- B. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.6 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage from paint application. Correct damage to work of other trades by cleaning, repairing or replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.7 INTERIOR PAINTING SCHEDULE

- A. Concrete Wall Surfaces: Provide the following paint systems over interior concrete substrates:
 - 1. Flat Acrylic Finish: Two finish coats over a primer.
 - a. Primer: Interior concrete primer; refer to Section 099123 “Interior Painting”.
 - b. Finish Coats: Interior flat acrylic paint.
 - 2. Low-Luster Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior concrete primer; refer to Section 099123 “Interior Painting”.
 - b. Finish Coats: Interior low-luster acrylic enamel.
- B. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
 - 1. Flat Acrylic Finish: Two finish coats over a primer.
 - a. Primer: Interior gypsum board primer.
 - b. Finish Coats: Interior flat acrylic paint.
 - 2. Low-Luster Acrylic-Enamel Finish: Two finish coats over a primer; typical for wall surfaces.
 - a. Primer: Interior gypsum board primer.
 - b. Finish Coats: Interior low-luster acrylic enamel.
 - 3. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior gypsum board primer.
 - b. Finish Coats: Interior semigloss acrylic enamel.
- C. Wood and Hardboard: Provide the following paint finish systems over new interior wood surfaces:
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a wood undercoater.
 - a. Primer: Interior wood primer for acrylic-enamel finishes; refer to Section 099123 “Interior Painting”.
 - b. Finish Coats: Interior semigloss acrylic enamel.
- D. Ferrous Metal: Provide the following finish systems over ferrous metal:
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.

- a. Primer: Interior ferrous-metal primer; refer to Section 099123 "Interior Painting".
 - b. Finish Coats: Interior semigloss acrylic enamel.
- E. Zinc-Coated Metal: Provide the following finish systems over interior zinc-coated metal surfaces:
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior zinc-coated metal primer; refer to Section 099123 "Interior Painting".
 - b. Finish Coats: Interior semigloss acrylic enamel.
- F. Cotton or Canvas and ASJ Insulation-Covering Substrates: Including pipe and duct coverings. Provide fungicidal agent to render fabric mildew-proof.
 - 1. Latex System:
 - a. Primer: Interior Flat Latex-Emulsion Size
 - b. Intermediate Coat: Interior flat acrylic paint
 - c. Topcoat: Interior flat acrylic paint.

END OF SECTION

SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall guards.
2. Corner guards.
3. Wall coverings.
4. Kick and armor plates.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for stainless-steel corner guards.
2. Section 087100 "Door Hardware" for stainless-steel mop, kick, armor, and push plates.

1.2 ACTION SUBMITTALS

- A. Product Data: For each product indicated.
- B. Sustainable Design Submittals: Refer to Division 01 Section "Sustainable Design Requirements."
- C. Shop Drawings: Include locations and extent of impact-resistant wall protection and details of installation.
- D. Samples: For each unit and for each color and texture required.

1.3 INFORMATIONAL SUBMITTALS

- A. Embodied Carbon Submittals: Refer to Section 018133 "Sustainable Design Requirements - Embodied Carbon."

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish full-size units of maximum length, including vinyl plastic cover and aluminum retainer, equal to 2 percent of each type, color, and texture of each type of unit installed, but no fewer than two units.

1.6 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide components with flame-spread and smoke-developed indices of not more than 25 and 450, respectively, when tested per ASTM E 84 by a testing agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: The design for each impact-resistant wall protection unit is based on the product named in the drawings. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
 1. American Floor Products Co., Inc.
 2. Arden Architectural Specialties, Inc.
 3. Balco, Inc.
 4. Boston Retail Products.
 5. Construction Specialties, Inc.
 6. IPC Door and Wall Protection Systems, Inc.
 7. Koroseal Wall Protection Systems, Inc.
 8. K. J. Miller Corp.
 9. Pawling Corporation.
 10. Tepromark International, Inc.
 11. Tri-Guards, Inc.
 12. Wilkinson Company, Inc.

2.2 MANUFACTURED UNITS

- A. Basis-of-Design Product: Digitally Printed Sheet
 1. IPC Aspex™ Wall Protection (Dimensions; Thickness)
 - a. 48" x 120" (1.22m x 3.04m); .040" (1mm), standard
 - 1) Backing: Digitally reverse printed with protective backing.

MATERIALS

2.3 MATERIALS

- A. PETG sheet material shall be extruded from chemical and stain-resistant PETG with a matte finish. Rigid sheet shall be reverse printed by Inpro with customer supplied digital graphics. Printed sheet shall have a protective backing.
- B. Extruded Plastic: Textured, chemical- and stain-resistant, high-impact-resistant, PVC or acrylic-modified vinyl plastic; thickness as indicated; with a minimum impact resistance of 25.4 ft-lbf/in. (1356 J/m) of width when tested according to ASTM D 256, Test Method A.
- C. Aluminum Extrusions: Alloy and temper recommended by manufacturer for type of use and finish indicated, but with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), alloy 6063-T5.
- D. Stainless-Steel Plate: Type 304, minimum [0.0625 inch (1.6 mm)] [0.0312-inch (0.8 mm)] thick.
- E. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorroding metal screws, bolts, and other fasteners compatible with aluminum components, hardware, anchors, and other items being fastened. Use vandal-resistant fasteners where exposed to view.
- F. Medium-Density Fiberboard: ANSI A208.2, Grade MD; made with binder containing no urea formaldehyde.

2.4 FINISHES

- A. Customer Supplied Digital Graphics: High definition digital files shall be reverse printed on clear PETG sheet and sealed with a protective backer. Customer to supply custom artwork, with copyright clearance. Adobe Illustrator (AI) or Encapsulated Postscript (EPS) artwork is preferred, but most raster file types (e.g. TIFF, JPEG) are acceptable. Raster files to be submitted at full scale, 300 dpi, in an uncompressed format.

2.5 WALL GUARDS

- A. Crash Rails: Nominal 8 inches (203 mm) high by 1 inch (25 mm) deep; heavy-duty assembly with snap-on-type, rigid plastic cover installed over continuous aluminum retainer.
 - 1. Basis-of-Design Product: Refer to drawings..
 - 2. Cover: Extruded, rigid plastic, minimum 0.125 inch (3.18 mm) thick.
 - 3. Retainer: Continuous, one-piece, extruded-aluminum retainer; minimum 0.0625 inch (1.6 mm) thick; with continuous rubber or vinyl bumper cushion centered in extrusion.

- a. Mounting: Refer to drawings. .
- 4. Accessories: Prefabricated, injection-molded end caps and inside and outside corners with concealed splices, cushions, mounting hardware, and other accessories as required; field adjustable for close alignment with snap-on plastic covers.
 - a. Color: Matching plastic cover.

2.6 CORNER GUARDS

- A. Stainless-Steel Corner Guards: Paper-covered, satin-finish, 0.0625 inch (1.6 mm) minimum, stainless-steel sheet corner guards; with 90-deg ree turn, unless otherwise indicated; and formed edges.
 - 1. Basis-of-Design Product: Refer to drawings.
 - 2. Wing Size: Refer to drawings. .
- B. Stainless-Steel Mud-In Corner Trim:
 - 1. Basis-of-Design Product: Refer to drawings.

2.7 DOOR PROTECTION SYSTEMS

- A. Door Surface Protection: Protection plates; 0.060 inch (1.524 mm) thick minimum; fabricated from embossed, chemical- and stain-resistant, extruded, rigid plastic with beveled edges; and complying with ANSI/BHMA A156.6.
 - 1. Kick Plate: Refer to door hardware schedule.
 - a. Basis-of-Design Product: Refer to door hardware schedule.
 - 2. Armor Plate: Refer to door hardware schedule .
 - a. Basis-of-Design Product: Refer to door hardware schedule
 - 3. Push Plate: Refer to door hardware schedule .
 - a. Basis-of-Design Product: Refer to door hardware schedule.

2.8 FINISHES

- A. Plastic Color: As selected from manufacturer's full range.
- B. Metal Finishes: Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary covering before shipping.

1. Aluminum: Refer to door hardware schedule, Class II complying with AAMA 611.
2. Stainless Steel: Refer to door hardware schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Preparation: Complete finishing operations, including painting, before installing impact-resistant wall protection system components. Before installation, clean substrate to remove dust, debris, and loose particles.
- B. Install impact-resistant wall protection system components level, plumb, and true to line without distortions.
 1. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- C. 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.
- D. Immediately on completion of installation, clean plastic covers and accessories using standard ammonia-based household cleaning agent. Clean metal components according to manufacturer's written instructions.
 1. Remove excess adhesive using methods and materials recommended by manufacturer.

END OF SECTION

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Not all items listed may be part of this Project nor are all items listed. Refer to Drawings for complete scope. If TOILET, BATH, AND LAUNDRY ACCESSORIES are shown but not scheduled coordinate with Architect for desired product type prior to cost assumption.
- B. Section Includes:
 - 1. Public-use washroom accessories.
 - 2. Public-use shower room accessories.
 - 3. Private-use bathroom accessories.
 - 4. Hand dryers.
 - 5. Childcare accessories.
 - 6. Underlavatory guards.
 - 7. Custodial accessories.
- C. Related Requirements:
 - 1. Section 088300 "Mirrors" for frameless mirrors.
 - 2. Section 093000 "Tiling" for ceramic toilet and bath accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Include electrical characteristics.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify accessories using designations indicated.
- C. Delegated Design Submittal: For grab bars and shower seats.
 - 1. Include structural design calculations indicating compliance with specified structural-performance requirements.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranties: For manufacturer's special warranty.
- B. Embodied Carbon Submittals:
 - 1. Completed Environmental Product Declaration Reporting Form for each principal product type in this Section.
 - 2. For products with completed Environmental Product Declaration Reporting Forms claiming availability of an applicable EPD, provide the Product-Specific or Industry-Wide Type III Environmental Product Declaration (EPD) in compliance with ISO 14025.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data: For accessories to include in maintenance manuals.

1.5 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.
 - 2. Failures include, but are not limited to, visible silver spoilage defects.
- B. Manufacturer's Special Warranty for Hand Dryers: Manufacturer agrees to repair or replace hand dryers that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Structural Performance: Design accessories and fasteners to comply with the following requirements:
 - 1. Grab Bars: Installed units are able to resist 250 lbf (1112 N) concentrated load applied in any direction and at any point.

2. Shower Seats: Installed units are able to resist 360 lbf (1601 N) applied in any direction and at any point.

2.2 WASHROOM, BATHROOM, AND SHOWER ROOM ACCESSORIES

A. Toilet Tissue (Roll) Dispenser:

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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Basco, Inc.
 - d. Bobrick Washroom Equipment, Inc.
 - e. Bradley Corporation.
 - f. Brey-Krause Manufacturing Co.
 - g. Franklin Brass by Liberty Hardware Manufacturing Corporation; a Masco company.
 - h. GAMCO Specialty Accessories; a division of Bobrick.
 - i. Ginger by Brasstech, Inc.; a Masco company.
 - j. Seachrome Corporation.
 - k. Taymore Industries USA Inc.
 - l. Tubular Specialties Manufacturing, Inc.
2. Description, Mounting, Operation, Material, and Finish: As described by basis of design product called out in Drawings, and by location shown for installation.
3. Capacity: Designed for 4-1/2- or 5-inch- (114- or 127-mm-) diameter tissue rolls, unless otherwise indicated by basis of design product.

B. Paper Towel (Folded) Dispenser:

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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Brey-Krause Manufacturing Co.
 - f. GAMCO Specialty Accessories; a division of Bobrick.
 - g. Seachrome Corporation.
 - h. Tubular Specialties Manufacturing, Inc.
2. Description, Mounting, Capacity, Material, and Finish: Unit designed for dispensing C-fold or multifold towels, as described by basis of design product called out in Drawings, and by location shown for installation.
3. Lockset: Tumbler type, unless otherwise indicated by basis of design product.

4. Refill Indicator: Pierced slots at sides or front, unless otherwise indicated by basis of design product.
- C. Paper Towel (Roll) Dispenser:
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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. GAMCO Specialty Accessories; a division of Bobrick.
 - f. Tubular Specialties Manufacturing, Inc.
 2. Description, Mounting, Capacity, Material, and Finish: Unit designed for dispensing paper rolls, as described by basis of design product called out in Drawings, and by location shown for installation.
 3. Lockset: Tumbler type, unless otherwise indicated by basis of design product.
- D. Automatic Paper Towel (Roll) Dispenser:
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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. GAMCO Specialty Accessories; a division of Bobrick.
 2. Description, Mounting, Material, and Finish: Automatic motion sensing mechanism with user-adjustable delay and paper towel length, as described by basis of design product called out in Drawings, and by location shown for installation.
 3. Minimum Capacity: 8-inch- (203-mm-) wide, 800-foot- (244-m-) long roll, unless otherwise indicated by basis of design product.
 4. Lockset: Tumbler type, unless otherwise indicated by basis of design product.
- E. Waste Receptacle:
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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.

- e. Brey-Krause Manufacturing Co.
 - f. GAMCO Specialty Accessories; a division of Bobrick.
 - g. Tubular Specialties Manufacturing, Inc.
- 2. Description, Mounting, Capacity, Material, and Finish: As described by basis of design product called out in Drawings, and by location shown for installation.
 - 3. Liner: Reusable vinyl liner, unless otherwise indicated by basis of design product.
 - 4. Lockset: Tumbler type for waste receptacle, unless otherwise indicated by basis of design product.
- F. Combination Towel (Folded) Dispenser/Waste Receptacle:
- 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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. GAMCO Specialty Accessories; a division of Bobrick.
 - f. Tubular Specialties Manufacturing, Inc.
 - 2. Description, Mounting, Capacity, Material, and Finish: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle. As described by basis of design product called out in Drawings, and by location shown for installation.
 - 3. Retain first subparagraph below for recessed or semirecessed units. Designed for nominal 4-inch (100-mm) wall depth, unless otherwise indicated in Drawings.
 - 4. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels, unless otherwise indicated by basis of design product.
 - 5. Liner: Reusable, vinyl waste-receptacle liner, unless otherwise indicated by basis of design product.
 - 6. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle, unless otherwise indicated by basis of design product.
- G. Combination Towel (Roll) Dispenser/Waste Receptacle:
- 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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. GAMCO Specialty Accessories; a division of Bobrick.
 - f. Tubular Specialties Manufacturing, Inc.

2. Description, Mounting, Capacity, Material, and Finish: Combination unit for dispensing preset length of roll paper towels, with removable waste receptacle. As described by basis of design product called out in Drawings, and by location shown for installation.
3. Minimum Towel-Dispenser Capacity: 8-inch- (203-mm-) wide, 800-foot- (244-m-) long roll, unless otherwise indicated by basis of design product.
4. Liner: Reusable, vinyl waste-receptacle liner, unless otherwise indicated by basis of design product.
5. Lockset: Tumbler type for towel dispenser compartment and waste receptacle, unless otherwise indicated by basis of design product.

H. Soap Dispenser:

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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Brey-Krause Manufacturing Co.
 - f. GAMCO Specialty Accessories; a division of Bobrick.
 - g. Seachrome Corporation.
 - h. Tubular Specialties Manufacturing, Inc.
2. Description, Mounting, Capacity, Material, and Finish: Designed for manual operation and dispensing soap, as described by basis of design product called out in Drawings, and by location shown for installation.
3. Lockset: Tumbler type, unless otherwise indicated by basis of design product.
4. Refill Indicator: Window type, unless otherwise indicated by basis of design product.

I. Automatic Soap Dispenser Insert drawing designation:

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. Advanced Modern Technologies Corporation - AMTC.
 - b. AJW Architectural Products.
 - c. American Specialties, Inc.
 - d. Bradley Corporation.
 - e. GAMCO Specialty Accessories; a division of Bobrick.
 - f. Sloan Valve Company.
 - g. Stern Engineering Ltd.
2. Description, Mounting, Capacity, Material, and Finish: Automatic dispenser with infrared sensor to detect presence of hands, as described by basis of design product called out in Drawings, and by location shown for installation.

3. Refill Indicator: LED indicator, unless otherwise indicated by basis of design product.
4. Low-Battery Indicator: LED indicator, unless otherwise indicated by basis of design product.

J. Grab Bar:

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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Brey-Krause Manufacturing Co.
 - f. GAMCO Specialty Accessories; a division of Bobrick.
 - g. Oatey.
 - h. Seachrome Corporation.
 - i. Tubular Specialties Manufacturing, Inc.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch (1.3 mm) thick, unless otherwise indicated in Drawings.
 - a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin), unless otherwise indicated in Drawings.
4. Outside Diameter: 1-1/2 inches (38 mm).
5. Configuration and Length: As indicated on Drawings.

K. Sanitary-Napkin Disposal Unit:

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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Brey-Krause Manufacturing Co.
 - f. GAMCO Specialty Accessories; a division of Bobrick.
 - g. Seachrome Corporation.
 - h. Tubular Specialties Manufacturing, Inc.
2. Description, Mounting, Material, and Finish: As described by basis of design product called out in Drawings, and by location shown for installation.
3. Receptacle: Removable, unless otherwise indicated by basis of design product.

L. Seat-Cover Dispenser:

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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Brey-Krause Manufacturing Co.
 - f. GAMCO Specialty Accessories; a division of Bobrick.
 - g. Seachrome Corporation.
 - h. Tubular Specialties Manufacturing, Inc.
2. Description, Mounting, Material, and Finish: As described by basis of design product called out in Drawings, and by location shown for installation.
3. Minimum Capacity: 250 seat covers, unless otherwise indicated by basis of design product.
4. Lockset: Tumbler type, unless otherwise indicated by basis of design product.

M. Mirror Unit:

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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Brey-Krause Manufacturing Co.
 - f. GAMCO Specialty Accessories; a division of Bobrick.
 - g. Seachrome Corporation.
 - h. Tubular Specialties Manufacturing, Inc.
2. Frame: Stainless steel angle, 0.05 inch (1.3 mm) thick .
 - a. Corners: Welded and ground smooth.
3. Size: As indicated on Drawings.
4. Hangers: Manufacturer's standard rigid, tamper and theft resistant.

N. Hook:

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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Basco, Inc.

- d. Bobrick Washroom Equipment, Inc.
 - e. Bradley Corporation.
 - f. Brey-Krause Manufacturing Co.
 - g. Franklin Brass by Liberty Hardware Manufacturing Corporation; a Masco company.
 - h. GAMCO Specialty Accessories; a division of Bobrick.
 - i. Ginger by Brasstech, Inc.; a Masco company.
 - j. Seachrome Corporation.
 - k. Taymore Industries USA Inc.
 - l. Tubular Specialties Manufacturing, Inc.
2. Description, Mounting, Material, and Finish: As described by basis of design product called out in Drawings, and by location shown for installation.
- O. Shower Curtain Rod:
- 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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Basco, Inc.
 - d. Bobrick Washroom Equipment, Inc.
 - e. Bradley Corporation.
 - f. Brey-Krause Manufacturing Co.
 - g. GAMCO Specialty Accessories; a division of Bobrick.
 - h. Ginger by Brasstech, Inc.; a Masco company.
 - i. Seachrome Corporation.
 - j. Tubular Specialties Manufacturing, Inc.
 - k. Insert manufacturer's name.
 - 2. Description: 1-1/4-inch- (32-mm-) outside diameter, straight rod.
 - 3. Configuration: As indicated on Drawings
 - 4. Mounting Flanges: Concealed fasteners; in material and finish matching rod.
 - 5. Rod Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin), unless otherwise indicated in Drawings.
- P. Shower Curtain:
- 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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Brey-Krause Manufacturing Co.
 - f. GAMCO Specialty Accessories; a division of Bobrick.
 - g. Tubular Specialties Manufacturing, Inc.

2. Size: Minimum 12 inches (305 mm) wider than opening by 72 inches (1829 mm) high.
3. Material as selected from the following by Architect:
 - a. Vinyl, minimum 0.006 inch (0.15 mm) thick, opaque, matte.
 - b. Duck, minimum 8 oz. (227 g), white, 100 percent cotton.
 - c. Nylon-reinforced vinyl, minimum 9 oz. (255 g) or 0.008-inch- (0.2-mm-) thick vinyl, with integral antibacterial and flame-retardant agents.
4. Color: As selected from manufacturer's full range.
5. Grommets: Corrosion resistant at minimum 6 inches (152 mm) o.c. through top hem.
6. Shower Curtain Hooks: Chrome-plated or stainless steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

Q. Folding Shower Seat:

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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Brey-Krause Manufacturing Co.
 - f. GAMCO Specialty Accessories; a division of Bobrick.
 - g. Seachrome Corporation.
 - h. Tubular Specialties Manufacturing, Inc.
2. Description, Mounting, Configuration, Material, and Finish: As described by basis of design product called out in Drawings, and by location shown for installation.
3. Mounting Mechanism: Stainless steel, ASTM A480/A480M No. 4 finish (satin), unless otherwise indicated by basis of design product.
4. Dimensions: As indicated in Drawings, or if not indicated, as selected by Architect from manufacturer's full line of accessible units.

R. Soap Dish:

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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Basco, Inc.
 - d. Bobrick Washroom Equipment, Inc.
 - e. Bradley Corporation.

- f. Brey-Krause Manufacturing Co.
 - g. Franklin Brass by Liberty Hardware Manufacturing Corporation; a Masco company.
 - h. GAMCO Specialty Accessories; a division of Bobrick.
 - i. Ginger by Brasstech, Inc.; a Masco company.
 - j. Seachrome Corporation.
 - k. Taymore Industries USA Inc.
 - l. Tubular Specialties Manufacturing, Inc.
2. Description, Mounting, Configuration, Material, and Finish: As described by basis of design product called out in Drawings, and by location shown for installation.

S. Medicine Cabinet:

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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Basco, Inc.
 - d. Bobrick Washroom Equipment, Inc.
 - e. Bradley Corporation.
 - f. Brey-Krause Manufacturing Co.
 - g. GAMCO Specialty Accessories; a division of Bobrick.
 - h. Ketcham Cabinets & Accessories; division of Fred Silver & Company, Inc.
 - i. Seachrome Corporation.
 - j. Tubular Specialties Manufacturing, Inc.
2. Mounting: Recessed, for nominal 4-inch (100-mm) wall depth.
3. Size: 18 by 24 inches (457 by 610 mm).
4. Door: Framed mirror door concealing storage cabinet equipped with continuous hinge and spring-buffered, rod-type stop and magnetic door catch.
5. Shelves: Three, adjustable.
6. Material and Finish:
 - a. Cabinet: Steel with corrosion-resistant finish.
 - b. Mirror Frame: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 - c. Door: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 - d. Hinge: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 - e. Shelves: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

T. Facial Tissue Dispenser:

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. AJW Architectural Products.
 - b. American Specialties, Inc.

- c. Basco, Inc.
 - d. Bobrick Washroom Equipment, Inc.
 - e. Bradley Corporation.
 - f. Brey-Krause Manufacturing Co.
 - g. GAMCO Specialty Accessories; a division of Bobrick.
 - h. Seachrome Corporation.
 - i. Taymore Industries USA Inc.
 - j. Tubular Specialties Manufacturing, Inc.
 - k. Insert manufacturer's name.
- 2. Mounting: Recessed, unless indicated otherwise in Drawings.
 - 3. Depth: 2-5/8 inches (67 mm) 4 inches (102 mm).
 - 4. Material and Finish:
 - a. Dispenser Face: Stainless steel, ASTM A480/A480M No. 4 finish (satin) .
 - b. Cabinet: Steel with corrosion-resistant finish.
- U. Toothbrush and Tumbler Holder:
- 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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Basco, Inc.
 - d. Bradley Corporation.
 - e. Brey-Krause Manufacturing Co.
 - f. Franklin Brass by Liberty Hardware Manufacturing Corporation; a Masco company.
 - g. GAMCO Specialty Accessories; a division of Bobrick.
 - h. Taymore Industries USA Inc.
 - i. Tubular Specialties Manufacturing, Inc.
 - 2. Description, Mounting, Configuration, Material, and Finish: As described by basis of design product called out in Drawings, and by location shown for installation.
- V. Towel Bar:
- 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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Basco, Inc.
 - d. Bobrick Washroom Equipment, Inc.
 - e. Bradley Corporation.
 - f. Brey-Krause Manufacturing Co.

- g. Franklin Brass by Liberty Hardware Manufacturing Corporation; a Masco company.
 - h. GAMCO Specialty Accessories; a division of Bobrick.
 - i. Ginger by Brasstech, Inc.; a Masco company.
 - j. Seachrome Corporation.
 - k. Taymore Industries USA Inc.
 - l. Tubular Specialties Manufacturing, Inc.
- 2. Description, Mounting, Material, and Finish: As described by basis of design product called out in Drawings, and by location shown for installation.
 - 3. Mounting: Flanges with concealed fasteners.
 - 4. Length: As indicated in Drawings.

W. Towel Pin:

- 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. AJW Architectural Products.
 - b. Bobrick Washroom Equipment, Inc.
 - c. Bradley Corporation.
 - d. GAMCO Specialty Accessories; a division of Bobrick.
- 2. Description, Mounting, Configuration, Material, and Finish: As described by basis of design product called out in Drawings, and by location shown for installation.

X. Towel Ring:

- 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. AJW Architectural Products.
 - b. Bobrick Washroom Equipment, Inc.
 - c. Bradley Corporation.
 - d. GAMCO Specialty Accessories; a division of Bobrick.
- 2. Description, Mounting, Shape, Material, and Finish: As described by basis of design product called out in Drawings, and by location shown for installation.
- 3. Pin Material and Finish: Matching Ring.

Y. Towel Shelf:

- 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. AJW Architectural Products.
 - b. American Specialties, Inc.

- c. Basco, Inc.
 - d. Bobrick Washroom Equipment, Inc.
 - e. Bradley Corporation.
 - f. Brey-Krause Manufacturing Co.
 - g. Franklin Brass by Liberty Hardware Manufacturing Corporation; a Masco company.
 - h. GAMCO Specialty Accessories; a division of Bobrick.
 - i. Ginger by Brasstech, Inc.; a Masco company.
 - j. Seachrome Corporation.
 - k. Taymore Industries USA Inc.
 - l. Tubular Specialties Manufacturing, Inc.
- 2. Description, Mounting, Configuration, Material, and Finish: As described by basis of design product called out in Drawings, and by location shown for installation.
 - 3. Length: As indicated in Drawings.
- Z. Towel Rack:
- 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. AJW Architectural Products.
 - b. Basco, Inc.
 - c. Taymore Industries USA Inc.
 - d. Tubular Specialties Manufacturing, Inc.
 - 2. Description, Mounting, Capacity, Configuration, Material, and Finish: As described by basis of design product called out in Drawings, and by location shown for installation.

2.3 HAND DRYERS

- A. Warm-Air Dryer:
- 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. AJW Architectural Products.
 - b. American Dryer, Inc.
 - c. American Specialties, Inc.
 - d. Bobrick Washroom Equipment, Inc.
 - e. Bradley Corporation.
 - f. Excel Dryer Inc.
 - g. GAMCO Specialty Accessories; a division of Bobrick.
 - h. Saniflow Hand Dryer Corporation.
 - i. Sloan Valve Company.
 - j. Tubular Specialties Manufacturing, Inc.

- k. World Dryer Corporation.
 - 2. Description: Standard-speed, warm-air hand dryer.
 - 3. Mounting: Surface mounted.
 - a. Protrusion Limit: Installed unit protrudes maximum 4 inches (102 mm) from wall surface.
 - 4. Operation: Infrared-sensor activated with timed power cut-off switch.
 - a. Automatic Shutoff: At 40 seconds.
 - 5. Maximum Sound Level: 63 dB.
 - 6. Cover Material and Finish: As selected by Architect from manufacturer's full line of finish and color options.
 - 7. Electrical Requirements: 115 V, 20 A, 2300 W.
- B. High-Speed Air Dryer:
- 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. AJW Architectural Products.
 - b. American Dryer, Inc.
 - c. American Specialties, Inc.
 - d. Bobrick Washroom Equipment, Inc.
 - e. Bradley Corporation.
 - f. Excel Dryer Inc.
 - g. GAMCO Specialty Accessories; a division of Bobrick.
 - h. Mitsubishi Electric Corporation.
 - i. Saniflow Hand Dryer Corporation.
 - j. Sloan Valve Company.
 - k. World Dryer Corporation.
 - 2. Description: High-speed, warm -air hand dryer for rapid hand drying.
 - 3. Mounting: Surface mounted.
 - a. Protrusion Limit: Installed unit protrudes maximum 4 inches (102 mm) from wall surface.
 - 4. Operation: Infrared-sensor activated with timed power cut-off switch.
 - a. Average Dry Time: 12 seconds.
 - b. Automatic Shut Off: At 60 seconds.
 - 5. Maximum Sound Level: 69 dB.
 - 6. Cover Material and Finish: As selected by Architect from manufacturer's full line of finish and color options.
 - 7. Electrical Requirements: 115 V, 20 A, 2300 W.

C. Multiple-Airflow Hand Dryer:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Specialties, Inc.
 - b. Bradley Corporation.
 - c. Dyson Technologies Limited.
 - d. Mitsubishi Electric Corporation.
 - e. Saniflow Hand Dryer Corporation.
 - f. World Dryer Corporation.
2. Description: Multiple-airflow hand dryer, using two or more airstreams for rapid hand drying with heating unit on-off control.
3. Mounting: Surface mounted.
 - a. Protrusion Limit: Installed unit protrudes maximum 4 inches (102 mm) from wall surface.
4. Operation: Electronic-sensor activated with timed power cut-off switch.
 - a. Average Dry Time: 12 seconds.
 - b. Automatic Shut Off: At 60 seconds.
5. Maximum Sound Level: 56 dB.
6. Water Collection: Removable reservoir.
7. Filter: HEPA, replaceable.
8. Cover Material and Finish: As selected by Architect from manufacturer's full line of finish and color options.
9. Electrical Requirements: 115 V, 20 A, 2300 W.

2.4 CHILDCARE ACCESSORIES

A. Diaper-Changing Station:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Specialties, Inc.
 - b. Bradley Corporation.
 - c. Diaper Deck & Company, Inc.
 - d. Foundations Worldwide, Inc.
 - e. GAMCO Specialty Accessories; a division of Bobrick.
 - f. Koala Kare Products; a Division of Bobrick.
 - g. SafeStrap Company, Inc. (SSC, Inc.).
 - h. Tubular Specialties Manufacturing, Inc.

2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
 - a. Engineered to support minimum of 250-lb (113-kg) static load when opened.
3. Mounting: Semirecessed, with unit projecting not more than 1 inch (25 mm) from wall when closed, unless otherwise indicated in Drawings.
4. Operation: By pneumatic shock-absorbing mechanism.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin), with replaceable insulated polystyrene tray liner and rounded plastic corners, unless otherwise indicated in Drawings.
6. Liner Dispenser: Provide built-in dispenser for disposable sanitary liners.

2.5 UNDERLAVATORY GUARDS

A. Underlavatory Guard:

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. Buckaroos, Inc.
 - b. Plumberex Specialty Products, Inc.
 - c. Truebro by IPS Corporation.
2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.

2.6 CUSTODIAL ACCESSORIES

A. Custodial Utility Shelf:

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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Brey-Krause Manufacturing Co.
 - f. GAMCO Specialty Accessories; a division of Bobrick.
 - g. Tubular Specialties Manufacturing, Inc.

2. Description: With exposed edges turned down not less than 1/2 inch (13 mm) and supported by two triangular brackets welded to shelf underside.
3. Size: 16 inches (406 mm) long by 6 inches (152 mm) deep.
4. Material and Finish: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel, ASTM A480/A480M No. 4 finish (satin).

B. Custodial Mop and Broom Holder:

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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Brey-Krause Manufacturing Co.
 - f. GAMCO Specialty Accessories; a division of Bobrick.
 - g. Tubular Specialties Manufacturing, Inc.
2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
3. Length: 36 inches (914 mm).
4. Hooks: Four.
5. Mop/Broom Holders: Three Insert number, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 - a. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.
 - b. Rod: Approximately 1/4-inch- (6-mm-) diameter stainless steel.

C. Custodial Paper Towel (Folded) Dispenser:

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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Brey-Krause Manufacturing Co.
 - f. GAMCO Specialty Accessories; a division of Bobrick.
 - g. Seachrome Corporation.
 - h. Tubular Specialties Manufacturing, Inc.
2. Mounting: Surface mounted.
3. Minimum Capacity: 600 C-fold or 800 multifold towels.
4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
5. Lockset: Tumbler type.
6. Refill Indicator: Pierced slots at sides or front.

D. Custodial Paper Towel (Roll) Dispenser Insert drawing designation:

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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. GAMCO Specialty Accessories; a division of Bobrick.
 - f. Tubular Specialties Manufacturing, Inc.
2. Description: Lever-actuated mechanism permitting controlled delivery of paper rolls in preset lengths.
3. Mounting: Surface mounted.
4. Minimum Capacity: 8-inch- (203-mm-) wide, 800-foot- (244-m-) long roll.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin) Insert material and finish.
6. Lockset: Tumbler type.

E. Custodial Soap Dispenser:

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. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Brey-Krause Manufacturing Co.
 - f. GAMCO Specialty Accessories; a division of Bobrick.
 - g. Seachrome Corporation.
 - h. Tubular Specialties Manufacturing, Inc.
2. Description: Designed for manual operation and dispensing soap in liquid or lotion form.
3. Mounting: Deck mounted on vanity, or Deck mounted on lavatory, unless indicated otherwise in Drawings.
4. Capacity: Insert value 8 oz. (236 mL) min.
5. Materials: Insert requirements Stainless steel, ASTM A480/A480M No. 4 finish (satin).
6. Lockset: Tumbler type.
7. Refill Indicator: Window type.

2.7 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.8 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories 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.
 - 1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.
- C. Shower Seats: Install to comply with specified structural-performance requirements.

3.2 ADJUSTING AND CLEANING

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

END OF SECTION

SECTION 109900 - MISCELLANEOUS SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous specialty accessories for Pet Relief areas and where indicated on Drawings.

B. Related Requirements:

1. Section 102800.13 "Toilet and Bath Accessories" for washroom, child care, and custodial accessories.

1.2 COORDINATION

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

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.

B. Manufacturers Instructions: For installation , maintenance and repair.

1.4 INFORMATIONAL SUBMITTALS

A. Embodied Carbon Submittals:

1. Completed Environmental Product Declaration Reporting Form for each principal product type in this Section.
2. For products with completed Environmental Product Declaration Reporting Forms claiming availability of an applicable EPD, provide the Product-Specific or Industry-Wide Type III Environmental Product Declaration (EPD) in compliance with ISO 14025.
3. The Contractor is advised that the submission of the embodied carbon EPD materials to the USGBC is not required.

PART 2 - PRODUCTS

2.1 PET RELIEF AREA SPECIALTIES

- A. Pet Waste Bag Dispenser: Wall mount, lockable aluminum cabinet designed to store and dispense pet waste bags.
 - 1. As indicated on the Drawings.
- B. Pet Water Fountain: Refer to drawings.
- C. Pet Waste Bin: Refer to drawings.
- D. Dog Park Fire Hydrant: Replica fire hydrant, fabricated from glass-fiber reinforced resin, with anchor bolt mounting.
 - 1. As indicated on the drawings.
- E. Hand Sanitizer Dispenser: Wall mount, automated touchless hand sanitizer dispenser.
 - 1. Manufacturer: Georgia-Pacific. Coordinate with Owner if there is a typical dispenser used throughout the airport.
 - a. Product: EnMotion Gen2 Automated Touchless Soap and Sanitizer Dispenser (52060).
 - b. Finish: Stainless Steel.
 - c. Location: Confirm mounting location with Owner.
- F. Pet Waste Scoop and Rake:
 - 1. Product: Mutt Mitt Scoop Buddy, <https://muttmitt.com>.
 - 2. Location: Coordinate with Owner.

PART 3 - EXECUTION

3.1 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.
 - 1. Remove temporary labels and protective coatings.
 - 2. Replace damaged or defective items.

END OF SECTION

SECTION 111453 - AUTOMATED EXIT LANE BREACH CONTROL TECHNOLOGY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the manufacturing, delivery, installation and commissioning of a complete pedestrian exit lane breach control corridor. The exit lane breach control (ELBC) corridor shall consist of the wall support structure, glass walls, ceiling support structure, fully automatic doors, automatic gates, 3D Stereo Sensors, video analytic intruder detection, I/O for remote operation, activation sensors, safety sensors and all required hardware for securely anchoring the assembled unit to the finished floor. The unit shall have an "open ceiling" concept.

1.2 RELATED INFORMATION

- A. Section 087100 "Door Hardware" for lock cylinders for exit lane breach control corridor doors when in lockdown mode.
- B. Section 088000 "Glazing" for general requirements for handling and installation of factory-installed glazing products specified in this Section.
- C. Division 26 sections for electrical power conductors, cables, and conduits for electrical service to exit lane breach control corridor, including disconnect switches, and for conduit for low-voltage power and control wiring required for work of this Section.

1.3 REFERENCE STANDARDS

- A. American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI): www.asce.org:
 - 1. ASCE/SEI 7 Minimum Design Loads for Buildings and Other Structure
- B. American Architectural Manufacturer's Association (AAMA): www.aama.org:
 - 1. AAMA 2603 Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels
- C. ASTM International (ASTM): www.astm.org:
 - 1. ASTM B633 Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
 - 2. ASTM C1048 Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass
 - 3. ASTM C1172 Standard Specification for Laminated Architectural Flat Glass

4. ASTM F1941 Standard Specification for Electrodeposited Coatings on Threaded Fasteners
- D. Code of Federal Regulations (CFR):
 1. 16 CFR 1201 Safety Standard for Architectural Glazing Materials
 - 2.
- E. International Code Council (ICC): www.iccsafe.org:
 1. ICC A117.1 Accessible and Usable Buildings and Facilities (ANSI)
 2. ICC-ES AC193 Mechanical Anchors in Concrete Elements
 3. ICC-ES AC308 Post-Installed Adhesive Anchors in Concrete Element
- F. Safety Glazing Certification Council (SGCC): www.sgcc.org:
 1. Certified Products Directory
- G. U.S. Architectural & Transportation Barriers Compliance Board:
www.access-board.gov:
 1. Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities
- H. ANSI/CAN/UL Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems (UL325)
 1. Units must be tested and approved to meet UL325 and 2593, specifically section 29.4.3 for closing speed

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Conference: Conduct conference online prior to delivery of components. Include representatives of Contractor, Owner[, Architect], system Installer, Installers of electrical and data connections, and others affecting or affected by the Work. Review the following:
 1. Requirements of Contract Documents.
 2. Project access.
 3. Temporary security requirements.
 4. Work restrictions.
 5. Schedule coordination.
 6. Staging requirements.
 7. Temporary facilities and controls.
 8. Delivery, storage, and handling.
- B. Coordination:

1. Coordinate installation of exit lane breach control corridor with modification of existing floor, wall, and ceiling construction and connections to building services.
2. Coordinate installation of anchors and blocking indicated on approved exit lane breach control corridor shop drawings.

1.5 ACTION SUBMITTALS

- A. Product Data: For exit lane breach control corridor structure and detection system.
- B. Shop Drawings: For exit lane breach control corridor.
 1. Include plans, elevations, sections, and details. Show compliance with accessibility requirements through dimensioned diagrams.
 2. Installation-specific dimensioning, [including coordination of related existing ceiling, wall, and floor-mounted elements to remain] [including coordination of related new ceiling, wall, and floor-mounted elements specified elsewhere].
 3. Locations and requirements for recesses and attachments to other work, including general construction, anchorage methods and locations, and service connections and locations.
 4. Include diagrams for power, signal, and control wiring including dimensioned connection locations.
 5. Indicate finish and glazing details.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installation firm.
- B. Field quality-control reports.
- C. Warranty: Sample of unexecuted manufacturer warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For exit lane breach control corridor, to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer listed in this Section with minimum ten (10) years' experience in manufacture of similar products in successful use on similar projects, have at least fifty (50) lanes installed in the United States and able to provide exit lane breach control corridor meeting specified requirements.
 1. Maintenance Proximity: Qualified personnel located not more than 6 hours normal travel time from Installer's place of business to Project site.

2. Approval of Manufacturers and Comparable Products: Submit the following in accordance with project substitution requirements, within time allowed for substitution review:
 - a. Completed and signed Substitution Request form.
 - b. Product data, including certified independent data indicating compliance with requirements.
 - c. Samples of each finish component.
 - d. Sample submittal from similar project.
 - e. Project references: Minimum of five installations of similar equipment not less than two years old, with Owner contact information.
 - f. Sample warranty.
 - B. Installer Qualifications: Experienced Installer approved by exit lane breach control corridor manufacturer for installation of exit lane breach control corridor required for this Project, who has completed installations similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance.
 1. Installer must be OSHA 30 and OSHA 10 certified
 - C. Glazing Fabricator Qualifications: Certified by primary glazing manufacturer.
- 1.9 DELIVERY, STORAGE, AND HANDLING
- A. Protect components according to manufacturer's written instructions. Prevent damage from condensation, temperature changes, direct exposure to sun, or other causes.
- 1.10 WARRANTY
- A. Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of exit lane breach control corridor that demonstrate deterioration or faulty operation due to defects in materials or workmanship under normal use within warranty period specified.
 1. Warranty Period Drive and Detection Components: 1 year from date of completion of installation, testing, commissioning, and owner acceptance.
 2. Warranty Period, Fixed Structure: 1 year from date of completion of installation.
 3. Exit lane corridors shall not be used by passengers in normal functional use until the system is accepted in writing by the owner.
 - B. The warranty shall execute a three-tier approach to repairing downed units in the following manner:
 1. Tier 1 - The manufacturer shall train designated airport maintenance staff and provide a troubleshooting guide, to triage the down unit prior to contacting the manufacturer service support designee. The triage instructions shall attempt to resolve a high degree of potential issues causing down time by failure.

2. Tier 2 - Should Tier 1 triage attempts deem unsuccessful; the manufacturer shall provide a phone support contact to provide additional triage instructions. Internet access to the controls shall be required with access allowed by the owner.
 3. Tier 3 - Should Tier 2 triage attempts deem unsuccessful; the manufacturer shall dispatch a qualified technician to the downed unit to arrive within 72 hours. Internet access to the controls shall be required with access allowed by the owner.
- C. Exit lane corridors shall not be placed in service for passengers use until the system has been accepted in writing, by the owner.
- D. Continuing Maintenance Service Agreement (CSMA): If called for in the Request for Proposal (RFP), the manufacture shall be prepared to provide an extended maintenance agreement proposal to Owner for maintenance of exit lane breach control corridor by qualified personnel of assembly Installer, beyond the warranty period. The extended agreement shall cover either an additional three (3) or five (5) year period without requiring evaluation of the units. Units older than four (4) years may be evaluated by the manufacturer prior to accepting an extended maintenance plan.
- E. Preventative Maintenance Inspections (PM):
1. It is recommended each unit undergo a PM inspection six (6) months after commissioning, and one (1) time at the end of the warranty period. After the initial warranty period, it is recommended each unit undergo a PM inspection twice per year.
 - a. The PM Inspection shall verify operation of exit lane breach control corridor, adjust, alignment, lubricate as required to bring assembly into manufacturer's recommended clearance tolerances and to provide smooth operation for operating and sensor components.
 - b. Perform manufacturer's recommended tests to verify system is operating within published specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Provide **dormakaba Automated Exit Lane Model PIL-M02 16** Exit Lane Breach Control Corridor manufactured by:
dormakaba Americas
6161 E. 75th Street
Indianapolis, IN 46250
704-774-7368
bill.seibert@dormakaba.com
1. Comparable products of other manufacturers subject to approval by Owner in accordance with Instructions to Bidders and Division 01 General Requirements

- B. Source Limitations: Provide exit lane breach control corridors through one source from a single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in ADA-ABA Accessibility Guidelines for Buildings and Facilities and requirements of authorities having jurisdiction.
- B. Safety Glazing: Provide glass panels that comply with 16 CFR 1201, Category II requirements for safety glazing.

2.3 SYSTEM DESCRIPTION

- A. General: Provide manufacturer's standard exit lane breach control corridor. Where not otherwise indicated, provide manufacturer's products as indicated in published product literature and as required for complete exit lane breach control corridor.
- B. Exit Lane Breach Control Corridor: Floor-supported, self-supporting enclosure consisting of stainless steel framing and panels with glass infill panels, glazed doors, and hinged gates, forming a controlled-access secure path of travel configured to allow high-volume single-direction pedestrian movement, and to sense, deter, and provide local and remote notification for attempts to enter corridor from the restricted direction. The modular enclosure is equipped with a series of motion presence and video analytic sensors that detect unattended objects left within the corridor area. As pedestrians pass through the corridor, full-height and half-height double swing doors automatically open and close based upon selected operating mode. Combined, the physical barrier and sensor system provide secure detection, entry prevention, and separation of facility users from persons posing a risk to the public.
 - 1. Aluminum-framed, stainless steel-clad structural components do not meet the requirements of this specification. Top and bottom rails will be extruded aluminum profiles with stainless steel cladding. Portals and visible parts will be finished in stainless steel.
- C. System Configuration: As indicated on Drawings. Clear door and unit width shall be no less than 1120mm (44-1/8")

2.4 OPERATION MODE DESCRIPTIONS

- A. Free-Flow Mode: In the static position, two full-height door pairs and a half-height gate are closed and locked. As single or multiple users exiting the air side approach the unit, an activation sensor detects the users and opens airside set of doors. As the users proceed through the exit lane and approach the landside set of doors, an activation sensor detects the users and opens the landside doors and half-height gate, thus allowing continuous exit flow.

- B. Interlock Mode: In the static position, the two full-height door pairs are closed and locked; the half-height gates remain in the open position. As the single or multiple user exits the airside approach the unit, an activation sensor detects the user and opens the airside doors to allow user or group of users to proceed to the landside doors which remain in the closed and locked position. Once an adequate count of users fills the corridor compartment, a voice announcement shall advise the users to stand clear of the airside doors as they begin to close. Once the airside set of doors are clear, closed, and locked, the landside set of doors and half-height gate open and allow users to exit.
- C. Maintenance Mode:
 - 1. Secure Side: Key switch on secure side activates maintenance mode. Secure side full height doors remain open, while second set of full height doors and half-height gates remain closed and locked. All security features are disabled.
 - 2. (Optional) Non-Secure Side: Access control on non-secure side activates maintenance mode. Non-secure side full height doors and half-height gates remain open, while airside set of full height doors remain closed and locked. All security features are disabled.
- D. Lock Down Mode: Activated at unit panel or remotely; locks all doors.
- E. Hold Open Mode: Activated locally or remotely; opens all doors.

2.5 COMPONENTS

- A. Wall and Glazing Framing: Stainless steel formed shapes, of width and thickness standard with manufacturer, with the following features:
 - 1. Concealed wire chase at top and bottom rails.
 - 2. Limiting bottom profile / rail directing wheeled traffic away from wall.
 - 3. Electrical Cabinet within unit provided. No wiring shall be placed on top of the unit.
- B. Glass Wall Panels: Provide glass panels with safety glazing labeling.
 - 1. Laminated Glass: ASTM C 1172, consisting of two plies of fully tempered clear float glass, ASTM C1048, Kind FT, Condition A, Type I, Quality-Q3, with 0.060 inch (1.5 mm) thick polyvinyl butyral interlayer.
 - a. Glass used on walls shall be 3/8 inch (10mm) overall thickness.
 - b. Glass used on full height swing doors shall be 1/4" (6mm) overall thickness.
 - 2. Source Limitations for Glass: All glass shall be provided with the system, supplied by the manufacturer.
 - 3. Window Film: Provide translucent window film as scheduled in drawings.
- C. Ceiling Structure: Overhead soffits with sensor housings and LED lighting; otherwise, no physical ceiling.

1. Mesh Ceiling: If required to prevent objects from being thrown through the open ceiling a stainless-steel mesh shall be installed.
 - a. Mesh is made of stainless-steel
 - b. Square opening 10 x 10mm, 4 mm web width between holes, thickness 1.5 mm
- D. Floor Attachment: Rails supporting the wall panels shall be extruded aluminum profiles with stainless steel cladding. The floor anchoring system shall be provided by the manufacturer.
- E. Interlock Doors: Pair of full-height power-operated glass door panels, configured in one-way traffic pattern.
 1. Controls and sensors:
 - a. Microwave sensors open doors and gates; infrared sensors provide safety curtain when operating doors and gates.
 - b. 3D Stereo Sensor and Video analytics sensors on non-protected side recognize attempted passage from non-protected to protected side.
 - c. Floor and doors are configurable to meet the airports' safety/security needs, comprising of (11) eleven different zones.
 - d. Provide a total of twenty-two (24) various inputs and outputs for the airport to choose from.
 - e. Traffic lights indicate green for open/to proceed or red for closed.
 2. Power Door Operators - EACH door leaf shall have its own drive unit:
 - a. Closing Speed: Less than 2.0 seconds.
 - b. Supply (1) low energy drive unit per door leaf
 - c. Locking Force: 1,843 lbs.
- F. Automatic Gates: One or more pairs of power-operated fast-closing swinging gates made of PETG panels, configured in one-way traffic pattern, with a directional plaque mounted on each panel within the lane. Opening and closing safety sensors are located on the non-secure side of interlock doors. Light grids running throughout the length of the corridor and a safety curtain provided by active infrared sensors are used in combination with low energy drive units to provide for pedestrian safety.
 1. Nonsecure Side Controlled Access: Owner supplied access control for unit service.
 2. Power Gate Operators:
 - a. Closing Speed: Less than 0.6 seconds.
 - b. Locking Force: 88 lbs.
- G. Door Operator Settings under Special Condition Failure:

1. Component: Airside doors close and lock; landside doors and gates lock in open position.
 2. Power Outage: Airside doors close and lock; landside doors and gates remain unlocked.
 3. Emergency Evacuation:
 - a. Fail Secure: Airside doors lock in a closed condition; landside doors and gates shall be in an unlocked condition to prevent any chance of entrapment.
- H. Interior Lighting: Manufacturer's standard LED lighting systemPower Requirements: 120VAC, 20A dedicated circuit. Halogen lighting is not permitted.
1. Refer to Division 26 electrical power section for online UPS and surge control serving this unit as recommended by system manufacturer.
- I. Thrown-in Object Detection: Sensor array configured to detect objects thrown into the exit lane corridor from the landside.
- J. Lighted Directional Signals: Animated arrow signals in a flat screen display directing pedestrian traffic (in lieu of pictographs).
- K. Signage: Provide a vinyl graphic on each door of the system. Verify the symbol, message, and location with the owner and coordinate with exit lane manufacturer.

2.6 SECURITY SYSTEM

- A. General: Provide manufacturer's standard inside corridor and exit side security packages providing presence detection, object detection, and reverse flow detection, with local and remote alarm and access control interface capabilities.
- B. Inside Corridor Security Package: Object detection camera system and floor-scanning light grids providing presence and abandoned object detection. Multiple zone microwave motion sensors detect reverse motion within corridor, setting off pre-alarm followed by full alarm, released by user leaving the corridor on the secured side before reentering.
- C. Exit Side Security Package: Video analytics providing detection of reverse user flow, with audible pre-warning followed by full alarm and lockdown initiation. Half-height gates close immediately followed by the closing of full-height doors. System actively scans to identify if user turns and leaves corridor, allowing system to reset and reopen or to remain in full shutdown pending manual reset. video analytics set off pre-alarm or full alarm which initiates closing of gates and doors, depending on the position of the intruder within the corridor.
- D. Control Interface: Interactive touch Panel with LED error code display, controls for switching functional modes, with input port and dry contacts for remote operation.
- E. Unit must have (26) twenty-six different Inputs/Outputs for the airport to choose from.

- F. Voice Annunciation System: Programmable voice module with most likely about 2MB storage capacity and loudspeaker, integrated into portal of interlock doors.

2.7 ACCESSORIES

- A. Hardware and Accessories, General: Manufacturer's standard operating hardware and accessories.
- B. Structural Anchors: For applications indicated to comply with certain design loads, use manufacturer-furnished fasteners, or provide fastener systems with working capacity greater than or equal to the design load.

2.8 FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Stainless Steel Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. Finish: Directional Satin Finish, No. 4.
 - 3. When polishing is completed, clean and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.9 FABRICATION

- A. Fabrication, General: Factory fabricate exit lane breach control corridor in accordance with approved shop drawings and published system descriptions.
- B. Glass Fabrication: Fabricate glazing panels in sizes, profiles, and configurations shown on Drawings.
 - 1. Provide holes and cutouts in glass to receive hardware, fittings, and accessories prior to tempering glass. Do not cut, drill, or make other alterations to glass after tempering.
 - 2. Factory glaze components indicated as factory glazed on approved shop drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. The Contractor shall evaluate and confirm the installation site conditions comply with the exit lane breach control corridor manufacturer's written requirements including tolerances, floor structure, lighting conditions, and concealed services, and are prepared for installation.
- B. The Contractor shall verify that the supporting floor meets the following requirements:
 - 1. Overall Levelness: Within 1/4 inch (6 mm) of design elevation indicated on approved shop drawings.
 - 2. Sloped floors shall be flat within 1/4 inch (6 mm) of design elevation, with the slope equal to slope indicated on approved shop drawings.
 - 3. Installed finished floor material and color matches flooring approved in advance by manufacturer.
- C. The Contractor shall validate electrical and communication system rough ins for compliance with approved shop drawings.
- D. Proceed with installation once conditions affecting installation and performance meet the manufacturer's written requirements.

3.2 INSTALLATION

- A. General: Install exit lane breach control corridor according to manufacturer's written installation instructions and approved shop drawings. Install unit in presence of manufacturer-authorized service representative.
- B. Install exit lane breach control corridor after other finishing operations have been completed.
- C. Install panels, doors and frames, railings, accessories, and installation materials required to provide a complete exit lane breach control corridor. Secure exit lane breach control corridor to building structure using manufacturer's recommended fasteners suitable for application. Install exit lane breach control corridor level and plumb.
- D. Tolerances: Install exit lane breach control corridor in accordance with the manufacturer's written instructions.
- E. Building Services Provided by Owner:
 - 1. Sprinkler heads in accordance with drawings and requirements of authorities having jurisdiction [and requirements of Division 21 sprinkler system sections].
 - 2. Electrical power service and data systems to the supplied exit lane corridor.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Manufacturer-authorized service representative shall test and inspect components, assemblies, and equipment installations, including connections to building services and system software.
- B. Remove and replace components, assemblies, and equipment installations that do not pass inspections or where inspections indicate that units do not comply with specified requirements.

3.4 ADJUSTING

- A. Adjust operable components to produce smooth operation and uniform fit. Confirm that locks engage accurately and securely.
- B. Replace damaged components.
- C. Lubricate hardware and other moving parts.

3.5 CLEANING

- A. Clean components in accordance with manufacturer's written instructions. Do not use cleaning agents or methods not approved by glass manufacturer.
- B. Clean exposed metal surfaces to factory new appearance.

3.6 DEMONSTRATION AND TRAINING

- A. Manufacturer-authorized service representative shall provide startup services and train Owner's personnel to adjust, operate, and maintain exit lane breach control corridor.

END OF SECTION

SECTION 123661 - SIMULATED STONE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quartz agglomerate countertops .

1.2 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

1.3 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Sustainable Design Submittals: Refer to Division 01 Section "Sustainable Design Requirements."
- C. Shop Drawings: For countertops. Show materials, finishes, edge profiles, and methods of joining.
- D. Samples for Verification: For the following products:
1. Countertop material, 6 inches (150 mm) square.
 2. One full-size quartz agglomerate countertop, with front edge, 8 by 10 inches (200 by 250 mm), of construction and in configuration specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Embodied Carbon Submittals: Refer to Section 018133 "Sustainable Design Requirements - Embodied Carbon."
1. Completed Environmental Product Declaration Reporting Form for the following principal product types in this Section:
 - a. Quartz Agglomerate Material.
 2. For products with completed Environmental Product Declaration Reporting Forms claiming availability of an applicable EPD, provide the Product-Specific or Industry-Wide Type III Environmental Product Declaration (EPD) in compliance with ISO 14025.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Include recommended cleaning materials and procedures, and list of materials detrimental to surfaces.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of simulated stone countertops.
- B. Environmental Product Declarations: For the following product types, obtain products with Product-Specific or Industry-Wide Type III Environmental Product Declaration (EPD) in compliance with ISO 14025. Industry-wide EPDs must demonstrate that the manufacturer is a member of the publishing body responsible for the product of the EPD.
 - 1. Particleboard.
 - 2. Plywood.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace simulated stone countertops that fail in materials or workmanship within specified warranty period.
 - 1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective simulated stone countertops.
 - 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOPS (SC#)

- A. Countertops: 1-1/4-inch- (32-mm-) thick, quartz agglomerate with front edge built up with same material.
- B. Fabrication: Fabricate tops in one piece with shop-applied edges unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

- C. Fabricate countertops in sections if one piece is not possible for joining in field, with joints at locations indicated and as follows:

- 1. Bonded Joints: 1/32 inch (0.8 mm) or less in width.

2.2 COUNTERTOP MATERIALS

- A. Particleboard: ANSI A208.1, Grade M-2.
- B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.
- C. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with the "Physical Characteristics of Materials" Article of ANSI SS1.
 - 1. Manufacturers: Subject to compliance with requirements, provide products according to the Finish Schedule in the Drawings.
 - 2. Colors and Patterns: As indicated by manufacturer's designations in Finish Schedule on Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean surfaces to receive countertops; remove loose and foreign matter that could interfere with adhesion.

3.2 INSTALLATION

- A. Install countertops in accordance with manufacturer's written instructions and approved Shop Drawings.
- B. Install countertops level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m) , and with no variation in plane between adjacent pieces at joint .
- C. For quartz agglomerate countertops, fasten by applying continuous bead of adhesive along all base cabinet surfaces, or if underlayment is used, apply continuous bead of adhesive along perimeter and around openings. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's recommended written instructions. Carefully dress joints smooth; remove excess adhesive and sealant, and clean entire surface.
 - 1. Bond joints with stone adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

- a. Fill joints with stone adhesive level with quartz surfacing.
- b. Clamp or brace quartz-agglomerate surfacing in position until adhesive sets.

3.3 CLEANING

- A. Clean countertops in accordance with manufacturer's instructions.

3.4 PROTECTION

- A. Protect installed countertops with non-staining covering.

END OF SECTION

SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 REFER TO RELATED SECTIONS

- A. Section 23 05 01 – Mechanical and Electrical Coordination
- Section 23 05 02 – Basic Mechanical Requirements
- Section 23 05 03 – Basic Mechanical Material and Methods
- Section 23 05 21 – Pipe and Pipe Fittings
- Section 23 05 22 – Piping Accessories
- Section 23 05 23 – Valves
- Section 23 05 29 – Pipe Support and Anchors
- Section 23 05 53 – Mechanical Identification

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION 21 05 00

SECTION 21 13 00 - FIRE SUPPRESSION SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide a complete fire protection system as indicated on the Drawings and as specified herein consisting of the following but not limited thereto.
 - 1. Wet fire sprinkler systems.
- B. It is the intent of this Specification for the Contractor to provide complete hydraulically designed wet and dry pipe sprinkler systems for the areas indicated in these Specifications and shown on the Contract Drawings. This Contractor shall be the Engineer of record for the fire sprinkler system. Furnish all design, material, and labor to complete the contract within the intent of these Specifications and Contract Drawings even though each and every item necessary is not specifically mentioned or shown.

1.2 QUALITY ASSURANCE

- A. Contractor Qualifications: Work shall be performed by a Contractor regularly engaged in the design and installation of fire protection systems in accordance with NFPA requirements and having at least three years continuous experience in this type of work. Experience shall include projects of similar type, size, and complexity.
- B. Design Criteria: Provide fire protection systems of type, pressure, flow, and density required by the prevailing edition of the NFPA 13 and regulatory agencies having jurisdiction.
 - 1. Systems shall be calculated and of configuration acceptable to regulatory agencies.
 - 2. Contractor to obtain a current flow test at the start of the project to verify need for fire pump and to use for the basis of the hydraulic calculations.
 - a. Contractor to notify the design team if the flow test is different than what is indicated and will impact the fire protection design.
 - 3. Provide sprinkler head densities per NFPA 13 and as shown on documents.
- C. Requirements of Regulatory Agencies: Total system shall be acceptable upon completion and testing in accordance with the requirements of the following:
 - 1. Jurisdictional Code Enforcement Agencies
 - 2. Jurisdictional Insurance Agency or Underwriter
 - 3. Confirm requirements of the authority having jurisdiction and Owner's Insurance Underwriter prior to bid.

- D. Certificate of Completion: Submit Certificate of Completion of fire protection work stating that the work has been completed and tested in accordance with the specified standards, that there are no defects in the system, and that it is operational.

1.3 CODES AND STANDARDS

- A. In addition to those specified in Section 21 05 00, comply with local fire department regulations and with the following:
1. International Building Code
 2. International Fire Code
 3. Local Water Department
 4. Local Building Department
 5. Local Health Department
 6. Local Public Works
 7. Prevailing editions of NFPA 13, 14, 24
 8. Local modifications to the Fire Codes
 9. UL 218 Standard for Fire Pump Controllers
 10. UL 1008 Automatic Transfer Switches
 11. UL 508 Industrial Control Equipment
 12. NFPA 20 Installation at Centrifugal Fire Pumps
 13. NFPA 70 National Electrical Code
- B. All materials and equipment used in the installation of the fire protection system shall be as listed in the Underwriters' Laboratories, Fire Protection Equipment Directory, or listed in the Factory Mutual Approved Guide, shall be the most current product of the manufacturer, and shall bear their label.

1.4 SUBMITTALS

- A. Submittal data shall be in accordance with Division 1 and the following shall be submitted for review to the Architect prior to the start of installation:
1. Material and equipment information shall include catalog cuts and technical data for each system component or device. This shall include, but not be limited to piping, fittings, globe and angle valves, OS&Y valves, butterfly valves, check valves, automatic sprinkler heads, escutcheons, hangers, flow switches, tamper switches, alarm valves, dry pipe valves, trim and required accessories, nitrogen generator, and air compressor.
- B. Prepare shop drawings showing layout of fire protection system. Use minimum scale of 1/8" = 1'-0" for floor plans. Drawings shall coordinate with all building structural features and components and show routing of piping to clear same. Drawings shall be accurately dimensioned to show proposed location of all fire protection system components. System design shall be completely coordinated with the architectural, structural, mechanical, and electrical features of the building. The drawings shall show all details required by NFPA 13 - Sprinkler System, Installation for "Working Drawings". In all areas with suspended ceilings, reflected ceiling plans shall be prepared showing the location of sprinklers, lights, diffusers, grilles, etc.

- C. Submit a complete schedule of the material and equipment proposed for this installation to the Architect/Engineer. Include catalog cuts, diagrams, drawings, and such other descriptive data as may be required to clearly show what, where, and how the component is intended to be installed. In the event any items of material or equipment contained in the schedule fail to comply with the specifications, such items may be rejected.
- D. Submit plans and hydraulic calculations signed and sealed by the Professional Engineer supervising the design of the fire sprinkler system and provide complete shop drawings of the sprinkler system to the regulatory agencies having jurisdiction. After reviewed submittals are obtained, submit the drawings and hydraulic calculations to the Architect for review. The Architect's written consent must be obtained before purchasing or installing any equipment.
- E. Acceptance of submittals will not relieve the Contractor of the responsibility for correcting any errors which may exist or for meeting requirements of the specifications. No partial submittals will be accepted.
- F. Final installation drawings shall be kept at the job site and marked to indicate all installation conditions which are different from the reviewed drawings.

1.5 DESIGN REQUIREMENTS

- A. It shall be the Contractor's responsibility to size the sprinkler system pipes in accordance with the requirements of the prevailing edition of NFPA 13. Contractor shall submit all calculations to the Engineer for review at time of drawing submittal. Submittal of these calculations to the Engineer will in no way relieve the Contractor of their responsibilities for complete and proper design of the fire protection system.
- B. It shall be the Contractor's responsibility to design the system so that no interferences exist between the fire protection system and work of other trades, equipment, and systems designed and installed by others. The latest issues of all architectural, structural, mechanical, and electrical drawings will be furnished for reference to assist the Contractor in preparing the design so as to avoid interference.
- C. This Contractor shall provide all necessary control wiring and equipment necessary for an operational system. This includes, but is not limited to: key switches, releasing panels, solenoid valves, etc.

1.6 WARRANTIES

- A. The entire new system shall be warranted to be free from defects for a period of one (1) year from the date of Notice of Acceptance.

1.7 PROJECT RECORD DOCUMENTS

- A. Upon completion of the work, the Contractor shall revise all fire protection drawings to agree with the construction as actually accomplished and stamp "As-Built". Those drawings where no

change is involved shall be likewise stamped. These "As-Built" drawings shall show the fire protection system as it existed at the completion of the contract work.

- B. See Division 1 for additional requirements.

1.8 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including the General Conditions of the Contract and Supplementary General Conditions and Division 1 - General Requirements, apply to work of this Section. This Contractor shall comply with all applicable sections of Division 21 through 23.

PART 2 - PRODUCTS

2.1 WET PIPE AND FITTINGS

- A. Pipe joints above ground shall be screwed, flanged, welded, or roll-grooved with mechanical couplings. Welded joints are not acceptable in pipe less than 2" in diameter. No welding permitted except with certified welders in shop.
- B. Piping above ground shall be ASTM A795 Schedule 40 black steel pipe. Thin wall ASTM A135 Schedule 10 black steel pipe may be used when in conformance with NFPA 13 and when allowed by the applicable Fire and Building departments.
- C. Threaded fittings above ground shall be ASTM A197 gray cast iron suitable for 175 psi cold water working pressure and so rated.
- D. In lieu of welded, threaded, or flanged connections, mechanical type couplings and fittings as manufactured by Tyco Grinnell Grooved Piping Products, Victaulic, or equivalent may be used in piping above grade.
- E. Provide escutcheons on penetrations of interior walls.
- F. Any piping used shall have a UL Corrosion Ratio (CRR) of 1.00 or greater.

2.2 BUTTERFLY VALVES

- A. Butterfly valves shall be furnished with worm gear type indicating operator to assure slow closing. Valves shall have a completely sealed shaft, integral flange seals, and hex drive.

2.3 OS&Y VALVES

- A. Outside stem and yoke gate valves shall be of the wedge disc type, shall permit straight line flow and complete shut-off, and shall be so designed that the valves can be packed under pressure when wide open. Valve shall be iron body, bronze trim, flanged or screwed ends, with rising stem and rated minimum 175 psi non-shock cold water service.

2.4 CHECK VALVES

- A. All swing check valves shall be 175 psi non-shock cold water service, iron body, bronzed trim, horizontal swing, with renewable bronze seat and rings. All check valves two (2) inches and smaller shall be bronze, screwed, horizontal swing type. All check valves two and one half (2½) inches and larger shall be flanged or grooved type.
- B. All wafer check valves shall be minimum 175 psi working pressure, iron body, with spring actuated double bronze plate and rubber seat.

2.5 GLOBE AND ANGLE VALVES

- A. Valves shall be furnished with renewable disc, non-shock, and shall back seat in the fully opened position to allow repacking under full pressure without removing the valve from the line. Valve shall be rated for minimum 175 psi working pressure.

2.6 VALVE SUPERVISORY SWITCHES

- A. All valves two inches or larger which control water to automatic sprinkler heads shall be equipped with supervisory switches having one normally open contact and one normally closed contact.

2.7 FLOW SWITCHES

- A. All flow switches shall be field adjustable vane type with pneumatic retard and 175 psi working pressure. Units shall be suitable for installation by drilling pipe and securing with U-bolt furnished with the switch. Units shall be single pole double throw, suitable for 24 Volt D.C. service with one normally open contact and one normally closed contact. Waterflow switches shall be adjusted so that the device will transmit a waterflow alarm within 30 seconds of opening the inspector's test valve on the sprinkler system.

2.8 TAMPER SWITCHES

- A. Acceptable manufacturers are System Sensor, Potter Electric, or equivalent.
- B. Switch shall be listed for use on the type of valve to be monitored.

2.9 AUTOMATIC FIRE SPRINKLER HEADS

- A. Acceptable manufacturers are Tyco, Viking, Reliable, Victaulic.
- B. Sprinkler heads shall have a temperature rating of 155°F except for heads in areas of high temperature or in close proximity to heat sources which shall be temperature rated in accordance with NFPA 13.
- C. Sprinkler heads in ceilings to be concealed pendent.

- D. Sprinkler heads in exposed areas shall be upright type, standard brass.
- E. Sprinklers for installation in wall, ceilings, soffits, or similar shall include integral escutcheon plates designed for friction or set screw fit. Escutcheon throat shall be minimum $\frac{3}{4}$ " depth.
- F. Flexible sprinkler hose fittings may be provided in ceiling areas. Provide Victaulic VS2 VicFlex or equivalent.
- G. Coordinate exact location, type, and color of all sprinkler heads, escutcheons, and plates with the Architect.
- H. Supply Owner an extra stock of six sprinklers minimum, three of each type, with applicable sprinkler wrenches. Sprinklers shall be packed in a suitable container for wall mounting. Provide additional heads that may be required by NFPA 13.

2.10 ALARM CHECK VALVES

- A. Acceptable manufacturers are Tyco, Viking, Reliable, and Victaulic.
- B. Alarm check valve shall provide for the proper functioning of a water motor alarm and/or electric alarm. Valve cover shall allow for replacement of all moving parts without removing the valve from an installed position. Valve shall have flanged or grooved connections. All moving parts shall be brass, bronze, or stainless steel with replaceable neoprene clapper and brass seat. Valve housing shall be tapped to allow installation of alarm accessories, two pressure gauges, (one above, and one below the seat) and main drain. Provide all accessories consisting of angle valves, globe valves, orifice restriction, pipe nipples and fittings, retarding chamber, water pressure gauges, and circuit closer with two sets of contacts for electric alarms. Valve shall be rated for 175 psi working pressure.

2.11 ALARM DEVICES

- A. Equipment necessary to accomplish a transmitted waterflow signal and auxiliary contacts shall be provided. Main shut-off valves shall be electrically supervised. Any tamper-proof switches required for testing the sprinkler system shall be furnished. Alarm devices shall be as manufactured by Potter Electric Signal Company or equivalent.
 - 1. Transmitted Alarm: A transmitted alarm shall be provided for the transmission of waterflow signals to the main fire alarm control panel. Wiring shall be provided in Division 26.

2.12 TEST AND STATUS CONNECTIONS

- A. Furnish and install test connection for fire protection system and pipe to appropriate drains.

2.13 MISCELLANEOUS

- A. Nameplate data information: The nameplates shall be installed on each main riser and shall include the following design data: building designation, location of remote area, design density, area of application, and system demand (GPM and PSIG at base of riser).
- B. Control valve signs: The Contractor shall provide a description sign, minimum dimensions seven (7) inches by nine (9) inches, for every valve in the preaction system which controls water to sprinkler heads. Signs shall be single faced, white letters on a red background, with a space designating who to notify if valve needs to be closed. Signs shall be fastened to each valve with lightweight chain.
- C. Miscellaneous signs: These signs for alarm test valves, main drains, auxiliary drains, etc. shall have minimum dimensions of two (2) inches by six (6) inches. Signs shall be single faced, white letters on a red background. Each sign shall be fastened to each valve with lightweight chain.

PART 3 - EXECUTION

3.1 PREPARATION

- A. The Contractor shall investigate the conditions affecting the work and shall arrange their work accordingly, providing such fittings, valves, and accessories as may be required to meet such conditions. The Contractor shall field verify all dimensions and conditions governing their work at the building. Materials shall not be fabricated or delivered to the site before the reviewed submittals have been received by the Contractor.

3.2 GENERAL INSTALLATION

- A. Investigate the structural and finish conditions affecting the work and arrange work accordingly, providing such fittings, valves, and accessories as may be required to meet such conditions. The Contractor shall field verify all dimensions and conditions governing their work at the building. Materials shall not be fabricated or delivered to the site before the final shop drawings and equipment submittals have been received by the Contractor.
- B. Entire installation shall be in accordance with the reviewed shop drawings. When unforeseen job site conditions will not permit piping to be installed as shown on the drawings, necessary changes will be made to accomplish a coordinated system without additional cost to the Owner, even though pipe may have been delivered to the site cut to predetermined lengths.
- C. Provide gate valves of size and at locations shown on the drawings and any additional valves required by local authorities. Locate all valves where readily accessible. Provide chain wheel operators or permanent ladders for all valves not accessible from the floor. All main line valves shall be electrically monitored or secured with a chain and padlock which will lock the valve in an open position.
- D. Provide check valves of size and at locations shown on the drawings and any additional check valves that might be required by local authorities.

- E. Provide valved test drains as required by NFPA. Pipe test drains to spill on grade whenever possible or to nearest floor drain, or receptor.
- F. Make provisions to drain all parts of the piping system.
- G. The hydraulic calculations shall be performed in accordance with the requirements of NFPA 13 and 14. The Contractor shall calculate the demand point for the system so that it remains ten (10) percent below the final water supply curve at the connection to the public water system. The demand point for the systems shall include an allowance for the inside and outside hose demand. The basis for the hydraulic calculations shall be determined by a waterflow test performed by the Contractor and acceptable to the Authority Having Jurisdiction.
- H. Be responsible for trenching, bedding material, removal of waste material, paving removal and replacement, barricades, and any materials necessary for vehicle and person access across work areas.
- I. Bedding shall be well graded non-expansive, non-organic soil containing no rocks over one (1) inch in diameter. There shall be no refuse or corrosive materials in this soil.
- J. All bedding and backfill shall be laid and compacted in accordance with Section 23 05 03 and Division 2.

3.3 PIPING INSTALLATION

- A. Perform the work in a professional workmanlike manner, according to the best practices of the trade. All sprinkler piping must be substantially supported from the building structure and only submitted and reviewed hangers shall be used. Sprinkler piping in all areas shall be concealed unless otherwise noted on the contract drawings. In those noted locations and in areas with no ceiling, piping shall be installed as high as possible using necessary fittings and auxiliary drains to maintain maximum height. Any deviations found necessary shall be immediately brought to the attention of the Architect. All piping discharging outside (main drains, inspectors test pipes) shall do so on paved surfaces or on splash blocks.
- B. All inside piping shall be joined by means of threaded, flanged, flexible gasketed joints, or other accepted method. Risers, feed mains, cross mains, and branch lines may be shop welded using appropriate welding fittings. Welding and brazing shall conform to the standards as set forth in NFPA 13. Welding and torch cutting shall not be permitted as a means of installing or repairing sprinkler system piping on-site.
- C. Provide expansion compensation loops at all building expansion joints and other areas where thermal and structural movement may require.
- D. Chrome-plated escutcheons shall be provided where exposed piping passes through finished floors, walls, partitions, and ceilings. Secure plates to pipe with set screws or spring clips.
- E. Refer to section 23 05 53 for pipe labeling requirements. Piping identification will also be subject to the requirements of applicable codes.

3.4 AUTOMATIC FIRE SPRINKLER HEAD INSTALLATION

- A. All sprinkler heads shall be aligned and parallel to ceiling features, walls, etc. The Contractor shall be responsible for the removal and replacement of ceilings, providing ceiling access panels, cutting, patching, and restoration of finishes as necessary.
- B. Conform to spacing and dimensional constraints indicated by the Architect on the reflected ceiling plans.
- C. Sprinkler heads shall be centered within ceiling grid.
- D. Flexible connectors shall be supported by structure to ensure that the maximum unsupported length does not exceed six feet.

3.5 FIRE STOPS AND PENETRATION SEALS

- A. All new piping penetrations through fire rated floors and walls shall be sealed with fire resistant sealant to prevent the spread of smoke, fire, toxic gas, and water through the penetration either before, during, or after a fire. The fire rating of the penetration seal shall be at least that of the floor or wall into which it is installed.
- B. See Section 23 05 03 for requirements.

3.6 PRESSURE GAUGE INSTALLATION

- A. Install pressure gauges at the following locations: street side of check valve and at system side of all control valves. Each gauge connection shall not be less than 1/4" and shall be equipped with a shut-off valve and with provision for draining.
- B. The required pressure gauges shall be 3" diameter minimum and shall have a maximum limit not less than twice the normal working pressure at the point where installed. They shall be installed to permit removal and shall be located where they will not be subject to freezing.

3.7 TAMPER SWITCH INSTALLATION

- A. Install tamper switches on all control valves.

3.8 FIRE ALARM WIRING

- A. All fire alarm and monitor wiring shall be done under the Electrical Division but the proper operation will be the fire protection Contractor's responsibility.

3.9 FLOOR CONTROL VALVE INSTALLATION

- A. Floor control valve shall be a complete assembly consisting of an OS&Y valve, grooved butterfly, or pressure control valve, vane type flow switch with retard chamber, inspector's test,

and main drain valves. Preassembled UL/FM floor control assemblies equivalent to Tyco Riser Manifolds are allowed.

- B. Pipe discharge from inspector's test and main drain valves through sight glass and orifice to a drain riser.
- C. This contractor shall install drain risers to serve floor control valves.

3.10 PIPE TESTING

- A. The entire fire protection piping system shall be tested hydrostatically at not less than 200 psi pressure for two hours, or at 50 psi in excess of the maximum static pressure when the maximum static of NFPA pressure is in excess of 150lbs. The hydrostatic test pressure shall be measured at the low point of the individual system or zone being tested. Each complete system (all associated piping and alarms), shall be tested and accepted as a complete unit, with data recorded on an accepted "Contractor's Material and Test Certificate". System pressure tests shall be against a blank test flange and not against a valve seat.
- B. All tests shall be conducted in the presence of the Architect and Owner. Any system failing to meet the specified test requirements shall be retested at no additional cost, until the test requirements are met.

3.11 MAINTENANCE AND OPERATIONAL INSTRUCTIONS

- A. System description, system theory of operation, and system final inspection and acceptance documents of the completed system (as built) shall be submitted in a bound book as described in Division 1. The maintenance manuals and instructions shall include a brief description of the type of system installed, routine-type maintenance work defined by step-by-step instructions that should be performed to ensure long life and proper operation, and the recommended frequency of performance. The instructions shall also include possible trouble spots with diagnosis and correction of each. The theory of operation brochures shall describe the function of each component or subassembly in block-diagram type presentation to a degree that a craftsman will understand the system well enough to operate and maintain it.

3.12 PROTECTION

- A. Protect all apparatus, fixtures, materials, equipment, and installations so as to prevent damage as a result of new work. The Contractor shall replace at their own expense any item, which is marred, defaced, broken, or damaged in any way, prior to the date of Notice of Acceptance.

END OF SECTION 21 13 00

SECTION 21 90 00 - FIRE SUPPRESSION SYSTEM PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 REFER TO RELATED SECTIONS

- A. Section 23 90 00 – Project Closeout

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION 21 90 00

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 REFER TO RELATED SECTIONS

- A. Section 23 05 01 – Mechanical and Electrical Coordination
- Section 23 05 02 – Basic Mechanical Requirements
- Section 23 05 03 – Basic Mechanical Material and Methods
- Section 23 05 13 – Motors and Starters
- Section 23 05 21 – Pipe and Pipe Fittings
- Section 23 05 22 – Piping Accessories
- Section 23 05 23 – Valves
- Section 23 05 29 – Pipe Support and Anchors
- Section 23 05 48 – Vibration Control
- Section 23 05 53 – Mechanical Identification

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION 22 05 00

SECTION 22 07 00 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 REFER TO RELATED SECTIONS

- A. Section 23 07 00 – Mechanical Insulation

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION 22 07 00

SECTION 22 10 00 - PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplemental Conditions of the Construction Contract and Division 1 Specification Sections (General Requirements), apply to this Section.

1.2 SUBMITTALS

- A. Submit manufacturer's data on the following:
 - 1. Water hammer arresters
 - 2. Piping products, fitting and connection methods
 - 3. Roof drains, floor drains, floor sinks, cleanouts and area drains
 - 4. Trap guards
 - 5. Thermostatic mixing valves

1.3 STANDARDS

- A. Materials shall comply with the following standards.
 - 1. Cast iron pipe:
 - a. ASTM A-74
 - b. CISPI 301
 - c. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute ® and listed by NSF® International
 - 2. Cast iron pipe fittings:
 - a. ASTM A-888
 - b. CISPI 301
 - c. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute ® and listed by NSF® International
 - 3. Cast iron pipe joints
 - a. Standard Duty Hubless Couplings shall conform to CISPI Standard 310 and ASTM C1277 and be certified by NSF® International
 - b. Heavy Duty Hubless couplings shall conform to ASTM C1540 and shall be used if indicated
 - 4. Gaskets for Service Weight hub & spigot shall conform to ASTM C564

5. Copper pipe:
 - a. Type K, L, M: ASTM B88
 - b. DWV: ASTM B306-88
6. Copper Fittings:
 - a. Pressure Fittings: ASME B16.22
 - b. DWV: ASME B16.29
7. Ductile iron pipe: AWWA C151, AWWA C115
8. Stainless Steel pipe:
 - a. ASTM A312
 - b. ASTM A778
9. Stainless Steel fittings:
 - a. ASTM F1548
 - b. ASTM F1476
10. All components in contact with potable water shall be listed for compliance with NSF 61 Lead Free requirements.

1.4 RELATED WORK

- A. Section 23 05 29 Pipe Supports and Anchors.

PART 2 - PRODUCTS

2.1 DOMESTIC WATER PIPING AND ACCESSORIES

- A. Above Ground Inside Building, Size 4" and Under:
 1. Pipe: Copper tube, hard temper, Type L
 2. Fittings: Wrought copper or cast bronze
 3. Solder: 95-5 tin antimony (no lead)
 4. Refer to section 230521 for other acceptable joining methods for copper tube 4" and smaller
- B. Use approved fittings for connections between dissimilar pipe systems.

2.2 WATER HAMMER ARRESTER (SHOCK ABSORBERS)

- A. Manufacturer:
 1. Design Basis: Sioux Chief 650 Series HydraRester
 2. Construction: Copper chamber with sealed piston
 3. Other Acceptable Manufacturers:
 - a. Smith

- b. Josam
 - c. PPP
 - d. Sioux Chief
 - e. Watts
 - f. Zurn
- 4. Standards: PDI WH201, ASSE 1010
 - 5. Must comply with NSF 61 and NSF/ANSI 372

2.3 TRAP GUARDS

- A. Manufacturers:
 - 1. Design basis: ProSet Trap Guard
 - 2. Acceptable Manufacturers:
 - a. Smith
 - b. Rectorseal
 - c. Zurn
 - 3. Construction: A flexible tube made of elastomeric material that is treated to roll up or pinch closed when water is passing through drain
 - 4. Comply with ASSE 1072
 - 5. Install in floor drains and floor sinks from 2" up to and including 4" as shown on plans indicated with a (TG) behind drain designation and in non-shower areas
 - 6. Use of trap guards is only acceptable if approved by local authority

2.4 SANITARY AND VENT PIPING (WITHIN BUILDING)

- A. Above Ground:
 - 1. Cast iron hub and spigot, neoprene gasket
 - 2. Cast iron no hub, neoprene gasket and stainless steel sleeve joint
 - 3. DWV copper with DWV fittings, solder joint
- B. Schedule 40 solid core PVC (If approved by local building department and Owner)Exposed in finished spaces:
 - 1. DWV copper with DWV fittings

2.5 HEAVY DUTY NO HUB COUPLINGS

- A. Heavy Duty Couplings shall conform to ASTM C1540.
- B. Use on the following:
 - 1. Sanitary vent piping 4" and larger
 - 2. Sanitary piping 3" and larger

- C. 1-1/2", 2", 3" and 4": 3" wide 304 stainless steel shield; (4) minimum stainless steel clamps; fixed and "floating" eyelet.
- D. 5" and over: 4" wide 304 stainless steel shield, with six (6) stainless steel clamps mounted in series.
- E. Torque to minimum 80-inch pounds or per manufacturer's recommendation.
- F. Acceptable manufacturers: Fernco, Husky Series 4000, Mission Heavy Weight, and Charlotte Pipe.

2.6 STANDARD DUTY COUPLINGS

- A. Standard duty couplings shall conform to ASTM C1277 and CISPI 310-85: 0.008" thick corrugated stainless steel.
- B. Use of the following:
 - 1. Sanitary vent piping up to and including 3" piping
 - 2. Sanitary piping up to and including 2" piping
- C. Torque to inch pounds per manufacturer's recommendation.
- D. Acceptable manufacturers: Fernco, Tyler, Mission, AB&I, Clamp All, Huskey, and Charlotte Pipe.

2.7 SOIL AND VENT PIPING PRODUCTS

- A. Use approved fittings for connections between dissimilar pipe systems.
 - 1. For transitions above slab, couplings shall conform to ASTM C1460
 - 2. For transitions below slab, couplings shall conform to ASTM C1173
- B. Manufacturers:
 - 1. Acceptable Manufacturers:
 - a. Smith
 - b. Jones Spec
 - c. Josam
 - d. Wade
 - e. Watts
 - f. Zurn
- C. Cleanout Plugs:
 - 1. Material: Cast bronze or brass
 - 2. Type: Countersunk
 - 3. Threads: ANSI B2.1

D. Wall Cleanout Covers:

1. Type: Frameless, round, low profile plate
2. Material: Stainless steel or chrome plated brass
3. Attachment: Single exposed flush screw
4. Finish:
 - a. Non-painted surfaces: Bright polished
 - b. Surfaces to be painted: Prime coat

E. Floor Cleanouts:

1. Body: Standard round Duco cast iron
2. Attachment: Bronze screws
3. Sleeve: Full thickness of floor slab
4. Top:
 - a. Shape:
 - 1) Where floor covering has rectangular pattern: Square
 - 2) Other areas: Round
5. Cover:
 - a. For Vinyl Tile and Similar Floor Coverings: Recessed to receive inset of floor material
 - b. For carpeted floor covering provide carpet cleanout marker
 - c. Other areas: Nickel bronze scoriated finish

2.8 STORM WATER PIPING (INSIDE BUILDING)

A. Above Ground:

1. Cast iron, hub and spigot, neoprene gasket joints
2. Cast iron no hub, neoprene gasket and stainless steel clamps
3. Schedule 40 galvanized steel with screwed or grooved mechanical fittings (Optional: Welded joints)

B. Underground:

1. Cast iron hub and spigot, neoprene gasket
2. Schedule 40 solid core PVC (As approved by local building department and Owner)

2.9 THERMOSTATIC AND DIGITAL MIXING VALVES

A. Individual or Group - ASSE 1070 Devices

PART 3 - EXECUTION

3.1 GENERAL

- A. Testing: Test in accordance with the applicable Plumbing Code.
- B. Connections to Equipment Furnished Under Other Sections:
 - 1. Make final connections to all equipment shown on drawings as connected to supply and/or drain piping.
 - 2. Furnish all devices necessary for final connection, including:
 - a. Tail pieces
 - b. Stops
 - c. Supplies
- C. Corrosion Protection:
 - 1. Provide isolation between concrete or mortar and any copper pipe.
 - 2. All below grade piping shall be adequately protected from corrosion.
- D. Comply with Section 23 05 29 Pipe Supports and Anchors for pipe support requirements.

3.2 INSTALLATION OF DOMESTIC WATER PIPING AND PRODUCTS

- A. Install all horizontal water piping level and parallel to building construction (except piping noted to be drained down slope toward drain at 1/8"/ft minimum). Make any changes in direction with fittings, don't kink or bend. All vertical piping to be plumb. Provide dielectric isolation between uninsulated pipe and hangers. Provide plastic grommets when going through metal studs. Tape is not acceptable for dielectric isolation.
- B. Grooved piping systems shall be installed in accordance with the manufacturer's latest published instructions. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Contractor shall remove and replace any improperly installed products.
- C. Water Hammer Arrestors:
 - 1. Provide water hammer arrestors in the piping systems and adjacent to all pieces of equipment wherein quick-closing valves are installed.
 - 2. Water hammer arrestors shall be properly sized and selected per PDI Standard WH 201 and having sufficient displacement volume to dissipate the calculated kinetic energy generated by the piping system. Install all units in a vertical position.
 - 3. Provide access panels.
 - 4. Install water hammer arrestors as close as possible to inlet side of quick closure valves and devices.
 - 5. Install water hammer arrestors in upright position on inlet side of solenoid valve.

6. Do not install water hammer arrestors at greater than 90-degree angle from vertical position.
7. Water hammer arrestors extended to above ceiling are not acceptable.

D. Disinfection:

1. After installation of all fixtures served, fill all domestic water lines with a chlorine-water solution of 50 parts per million minimum.
2. Hold solution in pipe for at least 24 hours.
3. Open and close all valves 3 times during chlorination.
4. Waste chlorine solution from each outlet.
5. The procedure shall be repeated where shown by a bacteriological examination that contamination remains present in the system.
6. Submit disinfection report to Architect and Engineer at successful completion.

3.3 INSTALLATION OF SANITARY AND VENT PIPING

A. Couplings: See Part 2 for use of standard and heavy-duty couplings.

B. Gaskets: Install gaskets in accordance with manufacturer's recommendations for the use of lubricants, cements, and other special installation requirements.

1. Joint Adapters: Make joints between cast iron pipe and other types of pipe with standard manufactured cast iron adapters and fittings.
2. All hubless couplings and fittings to be restrained from movement in accordance with CISPI Standard 310.
3. Make all cast iron joints as detailed in the Cast Iron Soil Pipe Institute's Handbook

C. Joint Adapters: Make joints between cast iron pipe and other types of pipe with standard manufactured cast iron adapters and fittings as detailed in Part 2.14.A.

D. Do NOT use compressed air or gases to test Drain, Waste, and Vent Systems or Storm Systems.

E. Cleaning Piping:

1. Clear the interior of pipe of dirt and other superfluous material as the work progresses.
2. Place plugs in the end of uncompleted pipe at the end of the day or whenever work stops.

F. Test Plugs:

1. Provide test plugs in floor drains and roof drains at the time of installation.
2. Leave test plugs in place for the duration of construction until sewer or drainage system is complete.

G. Cleanouts:

1. Provide cleanouts as required by code
2. Provide cleanouts for end runs of all water closet, urinal and lavatory batteries
3. Final locations of cleanouts to be approved by the Architect for all finish spaces

3.4 INSTALLATION OF STORM DRAINAGE PIPING (ABOVE GROUND WITHIN BUILDING)

A. Couplings:

1. Utilize heavy duty, 8 psi, hubless couplings for cast iron. Hubless cast iron may only be used on piping within 20' below the roof. This limitation is to prevent a failure of the hubless couplings in the event of a downstream system blockage. In lieu of this restriction adequate relief or coupling restraints per 3.4.A.3, must be provided and approved by the engineer.
2. Threaded or mechanical couplings with galvanized piping are acceptable for all locations.
3. All hubless couplings and fittings to be restrained from movement in accordance with CISPI Standard 310.

B. Gaskets: Install gaskets in accordance with manufacturer's recommendations for the use of lubricants, cements, and other special installation requirements.

C. Joint Adapters: Make joints between cast iron pipe and other types of pipe with standard manufactured cast iron adapters and fittings.

D. Cleaning Piping:

1. Clear the interior of pipe of dirt and other superfluous material as the work progresses.
2. Place plugs in the end of uncompleted pipe at the end of uncompleted pipe at the end of the day or whenever work stops.

E. Expansion and Contraction:

1. Provide a vertical expansion joint at each connection to roof drain unless an offset is provided.
2. Where piping crosses building expansion joints, provide swing or expansion joints to allow for building movement.
3. Provide isolation from expansive soils and settlement.
4. Provide expansion compensation devices for vertical stacks, long horizontal runs, building expansion joints, and other areas where pipe expansion is anticipated.

F. Downspout Nozzles: Install with flange secured to wall at base of concealed storm leaders that discharge through the building wall above grade.

G. Provide sway bracing and anchorage of piping as required by local code. At a minimum provide sway bracing at changes of direction greater than 45 degrees for pipes 4" or larger.

3.5 TRAP GUARDS

A. Install elastomeric trap guards in floor sinks and floor drains serving infrequently wetted areas.

END OF SECTION 22 10 00

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUBMITTALS

- A. Submit manufacturer's product data for plumbing fixtures and accessories, in accordance with Division 1.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All manufacturers are listed in alphabetical order and not by preference.
- B. Provide factory fabricated fixtures.
- C. Provide trim, carriers, valves, and accessories as required for complete installation.
- D. All carriers are floor mounted unless otherwise noted. All carriers shall be bolted down to floor structure.
- E. Refer to Drawings for "Plumbing Fixture Schedule".
- F. Comply with Local, State and Governing ordinances concerning maximum water requirements of plumbing fixtures:
 - 1. Water Closets: 1.28 gallons per flush
 - 2. Urinals: 0.125 gallons per flush
 - 3. Public Lavatories: 0.5 gallons per minute
 - 4. Private Lavatories: 1.5 gallons per minute
 - 5. Sinks: 2.0 gallons per minute
- G. All valves, fixtures, and accessories in contact with domestic water shall meet the requirements of NSF/ANSI Standard 61. Exception includes toilets, bidets, etc.

2.2 PLUMBING FIXTURES

- A. Acceptable Manufacturers:
 - 1. Water Closets, Urinals, Lavatories:
 - a. American Standard
 - b. Kohler
 - c. Sloan

- d. Toto
- e. Zurn
- 2. Faucets:
 - a. American Standard
 - b. Cambridge Brass
 - c. Chicago
 - d. Delta
 - e. Kohler
 - f. Moen
 - g. Sloan
 - h. Symmons
 - i. Toto
 - j. Zurn
- 3. Flush Valves
 - Diaphragm Type
 - a. Sloan
 - b. Zurn
 - Piston Type Flush Valves
 - a. Kohler
 - b. Sloan
 - c. Toto
 - d. Zurn
- B. Water Closets:
 - 1. Unless otherwise specified, all water closets are vitreous china water saver type, white.
 - 2. All flush valves, stops, and supplies are to be chrome plated brass. Flush valves to be non-hold open type. See section 2.3.
- C. Urinals:
 - 1. Unless otherwise specified, all urinals are vitreous china water saver type, white.
 - 2. All flush valves are to be chrome plated brass, non-hold open. See section 2.3.
- D. Lavatories:
 - 1. Unless otherwise specified, all lavatories are white.
 - 2. Provide chrome plated brass angle stops, supplies, tail piece, P trap, and grid strainer for all lavatories.
 - 3. Provide offset P traps on all ADA lavatory installations.

2.3 FLUSH VALVES

- A. Exposed diaphragm type, chrome plated flush valve. Valves will have paraflow diaphragm kit for flush discharge adjustment. Valve will be a non-hold open, and have no external volume adjustment. Valve will have ADA compliant handle, back check control stop will have a sweat

solder adapter kit with cast set screw with flange. Valve body, cover, tailpiece, and control stop will be in conformance with ASTM alloy classification. Valve will be in compliance with applicable sections of ASSE 1037 and ANSI A117.1 requirement for people with disabilities.

2.4 WATER CLOSET SEATS

A. Acceptable Manufacturers:

1. Beneke
2. Centoco
3. Church

B. Construction: Unless otherwise specified, seats shall be heavy duty solid plastic, white with open front, concealed self-sustaining check hinge less cover. Seat shall have an antimicrobial compound as an integral part of the plastic and shall match shape of bowl (elongated or regular).

2.5 FLOOR SINK

A. Acceptable Manufacturers:

1. Josam
2. JR Smith
3. Wade
4. Watts Ancon
5. Zurn

B. Body: Cast iron with acid-resisting porcelain enameled interior.

C. Rim and Grate: Nickel bronze

D. Provide with clamping collars with waterproof membrane clamps.

2.6 FLOOR DRAINS

A. Acceptable Manufacturers:

1. Josam
2. JR Smith
3. Wade
4. Watts Ancon
5. Zurn

B. Body: Duco cast iron, with flashing collar.

C. Grates and sediment strainers as specified in schedule.

- D. Provide primer taps as specified in schedule.
- E. Provide with clamping collars with waterproof membrane clamps.

2.7 FIXTURE TRIM

- A. Supply Pipe: 1/2" Polished chrome-plated pipe with angle stops and riser. Chrome-plated nipple to wall with chrome-plated escutcheon.
 - 1. Acceptable Manufacturers:
 - a. Chicago Faucets 1006-ABCP
 - b. McGuire LFH2165
 - c. T&S Brass B-1305
 - d. Approved Equal.
 - 2. Piping from valve stems to spout shall be Type L copper.
- B. Stainless steel flexible supplies:
 - 1. Plastic poly risers shall not be acceptable.
- C. Trap: 1-1/2" adjustable chrome-plated cast brass with clean-out plug, outlet and shall be:
 - 1. McGuire 8903, 1-1/2" x 1-1/2" or equal
 - 2. Traps shall be equipped with a Schuller Zeston "Snap-Trap" system or Truebro Lav Guard for handicap drain protection where required by ADA or local codes.
- D. Stops: 1/2" Quarter Turn compression x compression angle fitting, loose key. BrassCraft KTSCR or equal.
- E. Escutcheons: Set screw type, chrome plated brass. BrassCraft or equal. Split escutcheons will not be acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install each fixture with P trap with cleanout plug, easily removable for servicing and cleaning.
- B. Provide chrome plated, rigid or flexible supplies to fixtures with stops, reducers, and escutcheons.
- C. Finish wall and floor penetrations when exposed to view in finished areas with set screw type, chrome plated brass escutcheons.
- D. Set plumbing fixtures level and plumb, spaced in accordance with architectural dimensioned drawings, and securely install to be rigid.

- E. Install wall-mounted lavatories, urinals, and water closets with wall carriers mounted to the floor.
- F. Solidly attach floor-mounted carriers for all fixtures to floor using proper fasteners based on floor construction.
- G. Cover fixture bolts with china bolt caps of the same color where required.
- H. All wall-mounted fixtures to be caulked between fixture and wall.
- I. Securely anchor flush valves behind or within walls to be rigid and not subject to movement due to push or pull action on the valve.
- J. Fixture Mounting Heights:
 - 1. Refer to Architectural drawings and ADA standards.
- K. Floor Drains:
 - 1. Refer to Architectural drawings for exact locations and additional installation requirements.
 - 2. Install floor drains with P-traps and vent as required.
 - 3. Install drains on the center line of sheet lead pan and/or membrane in waterproofed areas and in floors above lowest floor.
 - 4. Clamp pan and/or membrane into drain flashing collar.
 - 5. Install strainers immediately after completion of finish floor installation.
 - 6. Coordinate locations with mechanical equipment.
 - 7. Install ASSE 1018 trap primers or ASSE 1072 trap guards as indicated.
- L. Install flushing mechanism for both ADA accessible flush valves and flush tanks to the side of water closet that has the most floor space per ADA requirements. Provide for ADA prescribed clearances between the top of the flush valve and grab bars.
- M. Provide a tempering valve that conforms to ASSE 1070 for all lavatories and sinks used as a public hand wash facility.

3.2 ADJUSTING AND CLEANING

- A. Cleaning:
 - 1. Clean strainers, traps, aerators, and valves of debris, sand and dirt.
 - 2. At completion, thoroughly clean plumbing fixtures and equipment.
- B. Adjusting: After cleaning and flushing operations are accomplished, adjust flush valves, faucets, showers, bubblers for proper flow.

3.3 PROTECTION

- A. Protect fixtures and related components from damage before, during, and after installation to date of Final Acceptance or Owner move-in. Provide protective coverings or other protection as required.
- B. Inspect each installed unit for damage to finish. If feasible, restore and match finish to original at site; otherwise, remove fixture and replace with new unit.
- C. Feasibility and match to be judged by Architect or Engineer.
- D. Remove cracked or dented units and replace with new units.
- E. Contractor shall be responsible for replacing damaged fixtures or components.

END OF SECTION 22 40 00

SECTION 22 90 00 - PLUMBING PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 REFER TO RELATED SECTIONS

- A. Section 23 90 00 – Project Closeout

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION 22 09 00

SECTION 23 05 01/26 05 01 - MECHANICAL AND ELECTRICAL COORDINATION

PART 1 - GENERAL

1.1 RESPONSIBILITY

- A. The Divisions 21 through 23 and 26 through 28 contractor(s) shall comply with the provisions of this section. The Divisions 21 through 23 contractor(s) shall verify electrical service provided by the electrical contractor before ordering any mechanical equipment requiring electrical connections. Provide submittals of all mechanical equipment to Division 26 through 28 contractor(s).
- B. The final responsibility for properly coordinating the electrical work of this section shall belong to the Divisions 21 through 23 system contractor performing the work, which requires the electrical power.
 - 1. Each Divisions 21 through 23 contractor shall be responsible for providing power wiring for certain devices as described in the specifications and on the drawings. This work shall be provided by a licensed electrician in accordance with all of the applicable provisions of the Division 26 through 28 specifications, NEC and local codes.

1.2 WORK INCLUDED

- A. Carefully coordinate the interface between Divisions 21 through 23 (Mechanical) and Divisions 26 through 28 (Electrical), and before submitting any equipment for review or commencing installation.

1.3 DEFINITIONS

- A. Automatic: Pertaining to a function, operation, process or device that, under specified conditions, functions without intervention by human operator.
- B. Disconnect Switch: A mechanical switching device used for changing the connections in a circuit, or for isolating a circuit or equipment from a power source.
- C. Motor Control Center: A floor-mounted assembly of one or more enclosed vertical sections having a common horizontal power bus and primarily containing motor starting units.
- D. Control Circuit/Power: The circuit which carries the electrical signals of a control apparatus or system directing the performance of the controller but does not carry the main power circuit.
- E. Manual Operation: Operation by hand without the use of any other power.
- F. MC: Mechanical Contractor = Divisions 21 through 23 Contractor who furnishes motor.
- G. TC: Temperature Controls = Division 23 09 00 Contractor who furnishes control.

H. EC: Electrical Contractor = Divisions 26 through 28 Contractor.

I. FA: Fire Alarm Contractor = Division 28 Contractor who furnishes Fire Alarm System.

1.4 RESPONSIBILITY SCHEDULE

A. Responsibility: Unless otherwise indicated, all motors and controls for Divisions 21 through 23 equipment shall be furnished, set in place and wired in accordance with the following schedule:

ITEM -	Furnished Under	Set In Place Under	Power Wiring Under	Control Wiring Under
MC: Mechanical Contractor TC: Temperature Contractor EC: Electrical Contractor FA: Fire Alarm Contractor				
Disconnect Switches (Note 1)	EC	EC	EC	--
Thermal Overload Switches (Note 1)	EC	EC	EC	--
Switches (Manual or Automatic other than disconnect) (Note 2)	MC or TC	MC or TC	EC or TC	TC or MC
Control Relays (Note 2)	MC or TC	MC or TC	--	TC
Control Transformers	MC or TC	MC or TC	EC or TC	TC
Push Button Stations, Pilot Lights	MC	EC	EC	EC
Thermostat and Controls: Integral with Equipment or Directly Attached to Ducts, Pipes, etc. (Note 2)	MC or TC	EC or TC	EC or TC	TC
Equipment in Temperature Control Panels	TC	TC	TC	TC
Valve Motors, Damper Motors, Solenoid Valves, etc.	TC	TC	TC	TC
EP Valves or Switches, P.E. Switches, etc.	TC	TC	--	TC
Fire Alarm System (Note 3)	FA	FA	EC	FA
Fire Sprinkler Alarm (Note 3)	MC	MC	EC	FA

Notes:

1. If furnished as part of factory wired equipment furnished and set in place by MC, wiring and connections by EC.
2. If float switches, line thermostats, P.E. switches, time switches, or other controls carry the FULL LOAD CURRENT to any motor, they shall be furnished by MC, but they shall be set in place and connected by EC, except that where such items are an integral part of the mechanical equipment, or directly attached to ducts, piping, or other mechanical equipment, they shall be furnished and set in place by MC and connected by EC. If they do not carry the FULL LOAD CURRENT to any motor, they shall be furnished, set in place and wired by TC contractor.
3. Pre-action system initiation signals (such as smoke detectors or general alarm conditions in a pre-action zone) shall be provided under Division 28.
4. Electrical contractor is responsible for wiring from starter to motor unless factory wired.
5. Temperature control contractor shall provide conduit and wire from auxiliary contact in motor starter to the detector so that the unit shuts down in all operating modes. Fire Alarm Contractor to wire from the detector to fire alarm panel.

6. Each division shall be fully responsible for any control panels as called for on the drawings or specifications.
 7. Division 26 shall provide all power and control wiring to fire/smoke or smoke dampers. Division 23 and 26 shall provide parallel control wiring (with 28 fire alarm having priority signal) to dampers and equipment utilized in both normal and smoke control modes. Refer to Smoke Control and Fire Alarm Drawings and the Fire Alarm Matrix.
 - a. Fire alarm system shall override automated building control system during smoke exhaust mode.
 - b. TC wiring to fire/smoke or smoke dampers required only when damper also serves HVAC system.
 8. FA wires to components necessary for the operation and monitoring of the Smoke Management System. TC wires to components utilized in the control and monitoring of the Automated Building Control System.
 9. Electrical contractor to provide shunt trip breaker or contactor to remove power from the equipment.
- B. Power Wiring by Divisions 21 through 23: The electrical power for certain equipment provided under Divisions 21 through 23 has not been specifically indicated on the electrical drawings and must be provided by and field coordinated by the Divisions 21 through 23 trade requiring such power.
- Sufficient power for this purpose shall be furnished as “spare” dedicated circuit capacity in Division 26’s panelboards. All wiring, conduit and electrical devices downstream of the panelboards are the responsibility of the Divisions 21 through 23 trade requiring the power.
1. Such equipment is hereby defined as:
 - a. Hardwired plumbing fixtures. Fixtures requiring power are shown on the plumbing drawings, specifications, or schedules. Provide junction box and or receptacle as required by manufacturer.
 - b. Building control panels, control air compressors and line voltage power for 24v control transformers. Required connections are included in Division 23 09 00 and will be shown by that contractor’s control submittal drawings.

1.5 GENERAL REQUIREMENTS

- A. Connections:
1. Connections to all controls directly attached to ducts, piping and mechanical equipment shall be made with flexible connections.
- B. Identification:
1. Provide identification of purpose for each switch and/or pushbutton station furnished. Identification may be either engraved plastic sign permanently mounted to wall below switch, or stamping on switch cover proper. All such identification signs and/or switch covers in finished areas shall match other hardware in the immediate area.

C. Control Voltage:

1. Maximum allowable control voltage 120V. Fully protect control circuit conductors in accordance with National Electrical Code.

1.6 CEILING AND CHASE CAVITY PRECEDENCE

- A. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electric systems within the cavity space allocation in the following order of precedence. A system with higher precedence may direct that systems of lower precedence be relocated from space, which is required for expedient routing of the precedent system.
1. Plumbing waste, cooling coil drain piping, and roof drain mains and leaders.
 2. Steam and condensate piping.
 3. Hydronic main piping (12" and larger).
 4. Plumbing vent piping.
 5. Supply, return and exhaust ductwork.
 6. Electrical conduit greater than 4" diameter.
 7. Hydronic branch and mains (greater than 2", but less than 12").
 8. Domestic water piping.
 9. Fire sprinkler mains and leaders.
 10. Hydronic branch piping (2" and less).
 11. Domestic hot and cold-water branches.
 12. Electrical conduit branch feeders.
 13. Fire sprinkler branch piping and sprinkler runouts.
- B. Light fixtures have precedence in a zone, which is the same height above the ceiling as the depth of the fixture (plus 2").
- C. Examine the contract documents of all trades (e.g. all Divisions 21 through 23 and 26 through 28 drawings, the architectural floor plans, reflected ceiling plans, elevations and sections, structural plans and sections, etc.).
- D. Coordinate necessary equipment, ductwork and piping locations so that the final installation is compatible with the materials and equipment of the other trades.
- E. Prepare shop drawings for installation of all new work before installation to verify coordination of work between trades.
- F. Provide access doors for all equipment, valves, clean-outs, actuators and controls which require access for adjustment or servicing and which are located in otherwise inaccessible locations.
1. For equipment located in "accessible locations" such as lay-in ceilings: Locate equipment to provide adequate service clearance for normal maintenance without removing architectural, mechanical, electrical or structural elements such as the ceiling support system, electrical fixtures, etc. "Normal maintenance" includes, but is not limited to: filter changing; greasing of bearings; using p/t ports for pressure or temperature measurements; and replacement of ballasts, fuses, etc.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION 23 05 01/26 05 01

SECTION 23 05 02 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. This Section supplements Division 1 - General Requirements.
- B. Where contradictions occur between this Section and Division 1, the more stringent of the two shall apply. Architect/Engineer shall decide which is more stringent.
- C. Provisions of this section shall also apply to all sections of Divisions 21 through 23.

1.2 DEFINITIONS

- A. The definitions of Division 1 and the General Conditions of this specification also apply to Divisions 21 through 23 contract.
- B. "Contract Documents" constitute the drawings, specifications, general conditions, project manuals, etc., prepared by Engineer (or other design professional in association with Engineer) for contractor's bid or contractor's negotiations with the Owner. Divisions 21 through 23 drawings and specifications prepared by the Engineer are not construction documents.
- C. "Construction Documents", "construction drawings", and similar terms for Divisions 21 through 23 work refer to installation diagrams, shop drawings and coordination drawings prepared by the contractor using the design intent indicated on the Engineer's contract documents. These specifications detail the contractor's responsibility for "Engineering by Contractor" and for preparation of construction documents.
- D. "(N)" indicates "new" equipment to be provided under this contract.
- E. "(E)" indicates "existing" equipment on site which may or may not need to be relocated as a part of this work.
- F. "(R)" indicates existing equipment to be relocated as part of this work.
- G. "Furnish" means to "supply" and usually refers to an item of equipment.
- H. "Install" means to "set in place, connect and place in full operational order".
- I. "Provide" means to "furnish and install".
- J. "Equal" or "Equivalent" means "meets the specifications of the reference product or item in all significant aspects." Significant aspects shall be as determined by the Architect/Engineer.
- K. "Work by other(s) divisions"; "re: ____ Division", and similar expressions means work to be performed under the contract documents, but not necessarily under the division or section of the

work on which the note appears. It is the contractor's sole responsibility to coordinate the work of the contract between their suppliers, subcontractors, and employees. If clarification is required, consult Architect/Engineer before submitting bid. By inference, any reference to a "contractor" or "sub-contractor" means the entity, which has contracted with the Owner for the work of the Contract Documents.

- L. By inference, any reference to a "contractor" or "sub-contractor" means the entity, which has contracted with the owner for the work of the Contract Documents.
- M. "Engineer" means the design professional firm, which has prepared these contract documents. All questions, submittals, etc. of this division shall be routed to the Engineer (through proper contractual channels).

1.3 COORDINATION WITHIN DIVISIONS 21 THROUGH 23

A. Contract Documents:

1. General: The Contract Documents are diagrammatic showing certain physical relationships, which must be established within the Divisions 21 through 23 work and its interface with other work. Such establishment is the exclusive responsibility of the Contractor. Drawings shall not be scaled for the purpose of establishing material quantities.
2. Supplemental Instructions: The exact location for some items in this Specification may not be shown on the Drawings. The location of such items may be established by the Architect/Engineer during the progress of the work.
3. The routing and various details necessary to allow for a fully coordinated installation are not established in the Contract Documents. Coordination including offsets, transitions, proportional duct size changes, routing paths, exact equipment locations, and other refinements are to be developed by the contractor through the coordination and shop drawing process. Such changes required to provide a fully coordinated and functional installation are not grounds for change orders.
4. Discrepancies:
 - a. Examine Drawings and Specifications of all Divisions of the work.
 - b. Report any discrepancies to the Architect/Engineer and obtain written instructions before proceeding.
 - c. Should there be a conflict within or between the Specifications or Drawings, the more stringent or higher quality requirements shall apply.
 - d. Items called for in either specifications or drawings shall be required as if called for in both.
5. Constructability:
 - a. Examine Drawings and Specifications of all Divisions of the work.
 - b. Report any issues to the Architect/Engineer which may prevent installation of Divisions 21 through 23 work in accordance with the Contract Documents and the original construction contract.
 - c. Report all issues within **90 days** after contract.

- B. Be responsible for providing proper documentation of equipment product data and shop drawings to all entities providing service. This coordination shall include, but not be limited to the following:
1. Division 21 - Series contractor (Fire Protection Contractor) shall provide shop drawings to all other Division 21 through 23 contractors.
 2. Division 23 09 00 and 23 05 93 - Contractors (Automatic Temperature Controls, Building Management and Test-Adjust-Balance Contractors) shall be provided with equipment product data and shop drawings as appropriate from other Division 21 through 23 and Divisions 26 through 28 contractors, and shall furnish the same information about control devices (such as valves, test wells, etc.) to the appropriate Divisions 21 through 23 Contractor.
- C. Coordination Drawings:
1. Submit coordination drawings for all Divisions 21 through 23 work. The drawings shall be fully coordinated and signed off by all affected trades prior to submission. The coordination drawings shall include the following at a minimum.
 - a. All major ductwork, piping, conduit and equipment.
 - b. Reflected ceiling plans with light fixtures.
 - c. Current architectural floor plans.
 - d. Major structural elements.
 - e. Elevations of piping ductwork or equipment.
 - f. Sections through critical spaces.
 2. The drawings shall be at a suitable scale (1/8"=1'-0" minimum) to clearly show information.
 3. Any work installed without reviewed coordination drawings is done at the Contractor's risk.
- D. Electronic Drawings:
1. Electronic drawings are available from ME Engineers. One complete set of electronic drawings in Revit or CAD format to be provided to GC for distribution. Electronic drawings are for reference only and available only upon receipt of electronic document disclaimer.
- E. Existing Conditions:
1. Inspect existing conditions prior to bidding.
 2. Provide proper coordination of mechanical work with existing conditions.
- F. Utility Connections:
1. Coordinate the connection of mechanical system with the Civil drawings and utility companies.
 2. Comply with regulations of utility suppliers.

3. The Contract Documents indicate the available information on existing utilities and services, and on new services (if any) to be provided to the project by utility companies and agencies.
 - a. Notify Architect/Engineer immediately if discrepancies are found.

1.4 COORDINATION WITH OTHER DIVISIONS

A. General:

1. Coordinate Divisions 21 through 23 work to the progress of the work of other trades.
2. Complete the entire installation as soon as the condition of the building will permit.

B. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electric systems within the cavity space allocation in the following order:

1. Plumbing waste, cooling coil drain, piping and roof drain mains and leaders.
2. Steam and condensate piping.
3. Hydronic main piping (12" and larger).
4. Plumbing vent piping.
5. Supply, return and exhaust ductwork.
6. Electrical conduit greater than 4" diameter.
7. Hydronic branch and mains (greater than 2", but less than 12").
8. Domestic water piping.
9. Fire sprinkler mains and leaders.
10. Hydronic branch piping (2" and less).
11. Domestic hot and cold-water branches.
12. Electrical conduit branch feeders.
13. Fire sprinkler branch piping and sprinkler runouts.

C. Coordination with Electrical Work. Refer to Section 23 05 01.

D. Cutting and Patching: Refer to Division 1 and Section 23 05 03.

E. Chases, Inserts and Openings:

1. Provide measurements, drawings, and layouts so that openings, inserts and chases in new construction can be built in as construction progresses.
2. Check sizes and locations of openings provided.
 - a. Any cutting and patching made necessary by failure to provide measurements, drawings, and layouts at the proper time shall be done at no additional cost to the Owner.
 - b. Coordinate roof openings for all roof-mounted equipment. Openings on documents are diagrammatic and do not represent manufacturer specific requirements. Actual opening size, orientation and location, as well as structural coordination, is the responsibility of the mechanical contractor.
 - c. Provide transitions on ductwork to accommodate actual roof openings.

1.5 COORDINATION WITH EXISTING OCCUPIED AREAS

- A. Minimize disruptions to operation of mechanical systems in occupied areas.
- B. Coordinate any required disruptions with the Owner, one week in advance.
- C. Provide temporary connections to prevent long disruptions.

1.6 ENGINEERING BY CONTRACTOR

- A. The construction of this building requires the contractor to design several systems or subsystems. All such designs shall be the complete responsibility of the contractor.
- B. Systems or subsystems which require engineering responsibility by the contractor include, but are not limited to:
 - 1. Fire sprinkler systems.
 - 2. Pipe hangers, sleeves, and anchors not specified in these documents or cataloged by the manufacturer.
 - 3. Fire stopping.
 - 4. Duct supports, hangers, and miscellaneous steel, as required.
 - 5. Temperature controls.
 - 6. Vibration Isolation.

1.7 REGULATORY REQUIREMENTS

- A. Codes: Comply with applicable codes indicated on drawings.
- B. Applicable pamphlets of NFPA.
- C. Requirements of Local Utility Companies:
 - 1. Comply with rules and regulations of local utility companies. Include in bid the cost of all valves, valve boxes, meter boxes, meters and such accessory equipment which will be required for the project.
- D. Other Regulations: Comply with the latest editions of the following:
 - 1. U.S. and State Department of Labor Safety Regulations pertaining to the completed project.
 - 2. Requirements of Fire Departments serving the project.
 - 3. Regulations of the Health Department having jurisdiction.
 - 4. Regulations of the Office of State Fire Marshal.
 - 5. ASHRAE Energy Conservation Standard 90A.
 - 6. ASHRAE Ventilation Standard 62.
 - 7. Requirements of the State Oil Inspector.
 - 8. Americans with Disabilities Act (ADA).
 - 9. Clean Air Act.

10. Colorado Air Quality Control Commission Regulation #15.
 11. Clean Water Act.
- E. Additional Regulations: Follow additional regulations, which appear in individual Sections of these Specifications.
- F. Contradictions: Where codes are contradictory, follow the most stringent, unless otherwise indicated in Plans or Specifications. Architect/Engineer shall determine which is most stringent.
- G. Contract Documents Not in Compliance:
1. Where the Drawings and Specifications do not comply with the minimum requirements of the Codes, either notify the Architect/Engineer, in writing during the Bidding Period, of the revisions required to meet Code requirements, or provide an installation which complies with the Code requirements. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.
 2. Follow Drawings and Specifications where they are superior to Code requirements.
- H. Permits:
1. Obtain all permits required by authorities and agencies having jurisdiction for the work of this Division.
 2. Post permits as required.
- I. Inspections and Tests:
1. Arrange for all required inspections and tests.
 2. Pay all charges.
 3. Notify Architect/Engineer 48 hours before tests.
 4. Submit one copy for Owners records of permits, licenses, inspection reports and test reports.

1.8 RECORD DRAWINGS

- A. General Recording Procedure:
1. Maintain a blue-line set of Divisions 21 through 23 Contract Drawings in clean, undamaged condition, for mark-up of installations, which vary, substantially from the Contract Drawings.
 2. Record changes drawn to scale and fully dimensioned, as specified in Division 1.
 - a. Work concealed behind or within other work, in an inaccessible arrangement.
 - b. Mains and branches of piping systems:
 - 1) with valves and control devices located and numbered.
 - 2) with concealed unions located.
 - 3) with items requiring maintenance located (traps, strainers, expansion compensators, tanks, etc.).
 - c. Underground piping and ducts, both exterior and interior.

- d. Ductwork layouts, including locations of coils, dampers, filters, boxes and similar units.
- e. Concealed control system devices and sensors.

B. Corrected Drawings:

- 1. Obtain a set of contract drawings on CAD.
- 2. Update the CAD files to reflect as-built conditions.
- 3. Transmit corrected CAD files and plots as a submittal to the Architect/Engineer for Owner's use and record.

C. Temperature Control Drawings:

- 1. Indicate as-built conditions of work under this contract including:
 - a. Ladder wiring diagram.
 - b. One line system diagram.
 - c. Control schematic of equipment with control devices located and identified.
 - d. Wiring or tubing termination diagrams.
 - e. List of materials.
 - f. Floor plan indicating all device locations.
 - g. Control sequences.
 - h. Indicate electrical power source for each point of connection to the electrical system.
- 2. Reproducible temperature control drawings shall be delivered to the Architect/Engineer prior to Owner's acceptance of project.

1.9 OPERATING AND MAINTENANCE DATA

- A. Refer to Division 1 for additional requirements.

1.10 WARRANTIES

- A. The warranty period is one year after Date of Acceptance.
 - 1. During this period, provide labor and materials as required to repair or replace defects in the mechanical system at no additional cost to the Owner. Provide certificate with O&M manual submittal which guarantees same-day service response to Owners call for all such warranty service.
 - 2. Provide certificates for such items of equipment which have warranties in excess of one year. Insert copies in O&M manuals. Such equipment shall include:
 - a. Temperature Control Valves five (5) years.
 - b. Chiller compressors five (5) years.
 - 3. Provide extended manufacturers warranties to cover one full year from date of acceptance if standard warranty starts any time prior to that date.

4. Provide factory trained service personnel for all warranty work on the DDC Control System.
- B. Refer to Division 1 for additional requirements.

1.11 SCOPE

- A. The Contractor shall:
 1. Supply all labor, transportation, materials, apparatus, light, and tools necessary for the completion of the mechanical work.
 2. Install, maintain, and remove all construction equipment.
 3. Be responsible for safe, lawful, and proper construction maintenance.
 4. Construct, in the best and most workmanlike manner, a complete project and everything properly incidental thereto, as shown on the Drawings, as stated in the Specifications, or reasonably implied therefrom, all in accordance with the Contract documents.

1.12 MANDATORY GOVERNING PROVISION

- A. Omissions of words or phrases, such as “the Contractor shall,” “in conformity with,” “shall be,” “as noted on the Drawings,” “according to the Drawings,” “an,” “the,” and “all,” are intentional.
- B. Omitted words or phrases shall be supplied by inference.

1.13 PROTECTION OF PROPERTY AND MATERIALS

- A. Provide protection against dust migration, rain, wind, storms, frost, or heat, so as to maintain all work, materials, apparatus, and fixtures free from injury or damage.
- B. At end of each day’s work, cover all new work likely to be damaged.
- C. Do not interrupt the integrity of the building security overnight.
- D. Refer to Division 1 for additional requirements.

1.14 OWNER FURNISHED EQUIPMENT

- A. All equipment called out in the Specifications or shown on the Drawings as “Owner-Furnished Equipment” shall be installed and connected under this Contract. Provide rough-ins for all future connections indicated.

1.15 TEMPORARY FACILITIES

- A. Light, Heat, Power, etc.
 - 1. Responsibility for providing temporary electricity, heat and other facilities shall be as specified in Division 1.
 - 2. Contractor shall be responsible for maintaining the equipment in an as-new condition. Equipment will not be turned over to the Owner until it is brought up to as-new condition.
 - 3. The contractor shall be responsible for maintaining acceptable indoor air quality in adjacent occupied spaces.
- B. Use of Permanent Building Equipment for Temporary Heating or Cooling.
 - 1. Permanent building equipment shall not be used without written permission from the Owner. If this equipment is used for temporary heating or cooling, it shall be adequately maintained per manufacturer's instructions and protected with filters, strainers, controls, reliefs, etc. The contractor shall protect all equipment and systems as directed by the engineer. The warranty period shall not start until the equipment is turned over to the Owner for their use. The contractor shall provide extended warranties for parts and labor for all such equipment. Equipment shall not be turned over to the Owner until the temperature controls have been tested and accepted by the Owner and Engineer.

1.16 INSTALLATION GENERAL REQUIREMENTS

- A. Furnish, apply, install, connect, erect, clean, and condition manufactured materials and equipment as recommended in manufacturer's printed directions (maintained on job site during installation).
- B. Provide all attachment devices and materials necessary to secure materials together or to other materials.
- C. Make allowance for ample and normal expansion and contraction for all building components and piping systems that are subject to such.
- D. Install materials only when conditions of temperature, moisture, humidity, and conditions of adjacent building components are conducive to achieving the best installation results.
- E. Erect, install, and secure components in a structurally sound and appropriate manner.
- F. Where necessary, temporarily brace, shore, or otherwise support members until final connections are installed.
- G. Leave all temporary bracing, shoring, or other structural supports in place as long as practical for safety and to maintain proper alignment.
- H. Handle materials in a manner to prevent scratching, abrading, distortion, chipping, breaking, or other disfigurement.

- I. Conduct work in a manner to avoid injury or damage to previously placed work.
- J. Any work so impaired or damaged shall be replaced at no expense to Owner.
- K. Fabricate and install materials true to line, plumb, and level.
- L. Leave finished surfaces smooth and flat, free from wrinkles, warps, scratches, dents, and other imperfections.
- M. Furnish materials in longest practical lengths and largest practical sizes to avoid all unnecessary jointing.
- N. Make all joints secure, tightly fitted, and as inconspicuous as possible by the best accepted practice in joinery and fabrication.
- O. Consult Engineer for mounting height or position of any unit not specifically indicated or located on Drawings or specified in Specifications.
- P. Job mixed multi-component materials used in the work shall be mixed in such regulated and properly sized batches that material can be used before it begins to “set”.
- Q. Mixing of a partially “set” batch with another batch of fresh materials will not be accepted and entire batch shall be discarded and removed from site.
- R. Clean all mixing tools and appliances that can be contaminated prior to mixing of fresh materials.
- S. In addition to the above refer to each Section of the Specifications for additional installation requirements for the proper completion of all work.

PART 2 - PRODUCTS

2.1 QUALITY CONTROL

- A. Refer to Division 1 of the Specifications.
- B. The manufacturer of equipment or materials listed on the drawings or specifically indicated in the specification is the basis of design. If the drawings and specifications are in conflict, the drawings shall take precedence. Other manufacturers listed are considered general equivalents only. See below for coordination of substitutions.
- C. Products by manufacturers not listed in this Specification may be submitted to the Engineer only during normal submittal procedure, and only as “substitutions”. All bids must use basis of design or listed general equivalents.
- D. Items submitted as a substitution to the basis of design or listed general equivalents shall be identified as such and shall include a written request for substitution indicating the following:
 - 1. Contract price adjustment.

2. Contract time adjustment.
 3. Item by item breakdown of differences between basis of design and substituted item.
 4. Operation, maintenance, and energy cost difference.
- E. Coordination of general equivalents and substitutions: Where Contract Documents permit selection from several general equivalents, or where substitutions are authorized, coordinate clearance and other interface requirements with mechanical and other work.
1. Provide necessary additional items so that selected or substituted item operates equivalent to the basis of design and properly fits in the available space allocated for the basis of design.
 2. Provide all features which are standard on the basis of design.
 3. Contractor is responsible for assuring that piping, conduit, duct, flue, and other service locations for general equivalents or substitutions do not cause access, service, or operational difficulties any greater than would be encountered with the basis of design.

2.2 GENERAL SUBMITTAL REQUIREMENTS

- A. Refer to Division 1.
- B. Coordination and Sequencing:
1. Coordinate submittals 2 weeks (min.) prior to expected order date so that work will not be delayed by submittals.
 2. No extension of time will be allowed because of failure to properly coordinate and sequence submittals.
 3. Do not submit product data, or allow its use on the project until compliance with requirement of Contract Documents has been confirmed by Contractor.
 4. Submittal is for information and record, unless otherwise indicated, and is not a change order request.
 5. Submitting contractor is responsible for routing reviewed submittals to all parties affected including but not limited to electrical, temperature control, and test and balance subcontractors.
- C. Preparation of Submittals:
1. Refer to Division 1 requirements.
 2. Provide permanent marking on each submittal to identify project, date, Contractor, Subcontractor, Supplier, submittal name and similar information to distinguish it from other submittals.
 3. Indicate any portions of work which deviate from the Contract Documents.
 - a. Explain the reasons for the deviations.
 - b. Show how such deviations coordinate with interfacing portions of other work.
 4. Show Contractor's executed review and approval marking.
 5. Provide space for Architect's/Engineer's "Action" marking.
 6. Submittals which are received from sources other than through Contractor's office will be returned "Without Action".

7. Submittals shall be presented in a neat and legible fashion and shall be returned “Without Action” if presented in any other fashion.
 8. Submittals shall have index with tab dividers for each component to facilitate locating information on specific pieces of equipment and products.
- D. Quantities: Unless otherwise indicated in Division 1, submit six copies.
1. Refer to Division 1 requirements.
 2. Multiple System Items: Where a required submittal relates to an operation or item of equipment used in more than one system, increase the number of final copies as necessary to complete the Maintenance Manuals for each system.
 3. Preliminary Submittal: Provide a preliminary, two-copy submittal for automatic temperature controls and when product data is required (or desired by Contractor) for selection of options by Architect/Engineer.
 4. General Distribution:
 - a. Provide additional distribution of submittals (not included in foregoing copy submittal requirements) to Subcontractors, Suppliers, Fabricators, Installers, Governing Authorities and others as necessary for proper performance of the work.
 - b. Include such additional copies in transmittal to Architect/Engineer where required to receive “Action” marking before final distribution.
 - 1) Show such distributions on transmittal forms.
- E. Response to Submittals: Where standard product data have been submitted, it is recognized:
1. That the Submitter has determined that the products fulfill the specified requirements.
 2. That the submittal is for the Architect’s or Engineer’s information only, but will be returned with appropriate action where observed to be not in compliance with the requirements.
- F. If more than two submissions (either for shop drawings, as-built drawings, or test and balance reports) are made by the contractor, the Owner reserves the right to charge the contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the contractor.

2.3 SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS

- A. Manufacturer’s Data:
1. Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided.
 2. Delete or mark-out significant portions of pre-printed data which are not applicable.
 3. Where operating ranges are shown, mark data to show portion of range required for project application.
 4. For each product, include the following:
 - a. Sizes
 - b. Weights
 - c. Speeds
 - d. Capacities

- e. Piping and electrical connection sizes and locations.
- f. Statements of compliance with the required standards and regulations.
- g. Performance data.
- h. Manufacturer's specifications and installation instructions.

B. Shop Drawings:

- 1. Prepare Mechanical Shop Drawings, except diagrams, to accurate scale.
 - a. Show clearance dimensions at critical locations.
 - b. Show dimensions of spaces required for operation and maintenance.
 - c. Show interfaces with other work, including structural support.

C. Test Reports:

- 1. Submit test reports which have been signed and dated by the firm performing the test.
- 2. Prepare test reports in the manner specified in the standard or regulation governing the test procedure (if any) as indicated.

D. Required equipment and shop drawing submittals:

- 1. Provide a submittal schedule with bid.
- 2. Provide equipment submittals for each item of equipment specified or scheduled in the contract documents.
- 3. Submittal Schedule shall show each item of equipment, applicable Section of the specifications where it is described, applicable Drawing number and schedule name where it is scheduled, date of Contractor's proposed submittal to Architect, required date to receive submittal from Architect and schedule order date.
- 4. Provide a Mechanical Shop Drawing Schedule for submission to the Architect with the Submittal Schedule. Refer to paragraph 1.3 -Coordination Within Divisions 21 through 23 above.
- 5. Review of shop drawings and product data by the Architect/Engineer, including any review annotations or stamp notations, does not relieve the contractor from the required compliance with the contract documents.
- 6. The shop drawing and product data review stamp notation requirements are defined as follows:
 - a. "NO EXCEPTION TAKEN:" The reviewer did not observe any items which were not in compliance with the contract documents. All dimensions, details, and coordination with other trades are the responsibility of the contractor.
 - b. "MAKE CORRECTIONS NOTED:" The reviewer indicated items observed that were not in compliance with the contract documents. The contractor shall not resubmit, but shall make corrections and provide corrected documents with the "Record Drawings."
 - c. "REJECTED, REVISE AND RESUBMIT:" The reviewer indicated items observed which were not in compliance with the contract documents. The contractor shall resubmit showing corrections of all noted items. Delays for resubmittal do not relieve the contractor from meeting project schedules.
 - d. "REJECTED:" The submission does not comply with the contract requirements. The entire submittal must be corrected and submitted for review. Delays for resubmittal do not relieve the contractor from meeting project schedules.

7. If shop drawings are submitted and returned as “NO EXCEPTION TAKEN” or “MAKE CORRECTIONS NOTED” and meet contract requirements, the contractor shall not resubmit any other shop drawings for these items.
8. If resubmittals are necessary, they shall be made as specified above for submittals. Resubmittals shall highlight all revisions made and cover shall include the phrase “RESUBMITTAL NO. _____.”
Resubmittal requirements do not entitle the Contractor to additional time and are not a cause for delay of the project.

2.4 COMPATIBILITY

- A. General: Provide products which are compatible with other products of the mechanical work and with other work requiring interface with the mechanical work.
- B. Altitude Ratings: Except where noted otherwise, all ratings and capacities stated in the Contract Documents are at the altitude of the project, not sea level. Project Altitude shall be considered to be 4700 feet.
- C. Power Characteristics:
 1. For power characteristics of equipment supplied under Division 21 through 23 Sections, refer to the Sections of Divisions 26 through 28 and the Electrical Drawings for the power characteristics of each power-driven item of mechanical equipment.
 2. Coordinate available power with Electrical Contractor before ordering equipment. Mechanical Contractor shall be responsible for ordering equipment to meet the available power characteristics.
 3. See also Division 23 05 01 of these specifications.
 4. If there is a conflict between Divisions 21 through 23 documents and Divisions 26 through 28 documents, alert the engineer. Do not order equipment prior to determining the proper electrical service. No contract cost adjustment will be allowed for equipment ordered in conflict with the available power characteristics.

PART 3 - EXECUTION

3.1 COORDINATION OF MECHANICAL INSTALLATION

- A. Inspection and Preparation:
 1. Examine the work interfacing with mechanical work, and the conditions under which the work will be performed, and notify the Architect/Engineer of conditions detrimental to the proper completion of the work at original contract price.
 2. Do not proceed with the work until unsatisfactory conditions have been corrected.
- B. Layout:
 1. Layout the mechanical work in conformity with the Contract Drawings, Coordination Drawings and other Shop Drawings, product data and similar requirements so that the

- entire mechanical plant will perform as an integrated system, properly interfaced with other work, recognizing that portions of the work are shown only in diagrammatic form.
2. Where coordination requirements conflict with individual system requirements, comply with the Architect's or Engineer's decision on resolution of the conflict.
 3. Take necessary field measurements to determine space and connection requirements.
 4. Provide sizes and shapes of equipment so the final installation conforms to the intent of the Contract Documents.
- C. Integrate mechanical work in ceiling spaces with suspension system, light fixtures and other work so that required performances of each will be achieved.
- D. Plumbing:
1. Coordinate plumbing chases to ensure piping and carriers will fit in provided chases. Carrier dimensions will be based on approved submittal. Notify Architect /Engineer if the chase is not wide enough for installation prior to shop or field fabrication and installation.
 2. Prior to installing water closet carriers and water rough-in, Contractor to coordinate ADA water closet height, flush valve length, and grab bar height to ensure proper clearance.
 3. Coordinate the size of base cabinets with fixture size for cabinet mounted sinks.

3.2 PRODUCT INSTALLATION

- A. Manufacturer's Instructions:
1. Except where more stringent requirements are indicated or where local code takes precedence, comply with the product manufacturer's instructions and recommendations.
 2. Consult with manufacturer's technical representatives, who are recognized as technical experts, for specific instructions on special project conditions.
 3. If a conflict exists, notify the Architect/Engineer in writing, and obtain their instruction before proceeding with the work in question.
- B. Movement of Equipment:
1. Wherever possible, arrange for the movement and positioning of equipment so that enclosing partitions, walls and roofs will not be delayed or need to be removed.
 2. Otherwise, advise Contractor of opening requirements to be maintained for the subsequent entry of equipment.
- C. Heavy Equipment:
1. Coordinate the movement of heavy items with shoring and bracing so that the building structure will not be overloaded during the movement and installation.
 2. Where mechanical products to be installed on the existing roof are too heavy to be hand-carried, do not transport across the existing roof deck; position by crane or other device so as to avoid overloading the roof deck.

D. Suspended Piping, Ductwork, Conduit, and Equipment

1. Suspend each trade's work independently from structure. Do not share hangers between piping, ductwork, conduit, and equipment.
2. Ductwork, piping, and conduit shall be held tight to structure above unless noted otherwise.

E. Return Air Path: Coordinate mechanical work in return air plenum to avoid obstructing return air path.

1. Do not make changes in layout which will reduce return air path cross-sectional areas. Minimum cross-sectional area will provide an average of 500 fpm and a maximum of 750 fpm velocity through return air plenum at specified supply air quantity unless otherwise noted.
2. Provide openings in any full height walls to allow for free movement of return air. Openings are to be sized for 500-750 fpm velocity. Notify the Architect/Engineer for any openings required in fire rated walls that are not shown on the contract drawings.
3. Report any obstructions by work of other Divisions to Architect/Engineer.

F. Clearances:

1. Install piping and ductwork:
 - a. Straight and true.
 - b. Aligned with other work.
 - c. Close to walls and overhead structure (allowing for insulation).
 - d. Concealed, where possible, in occupied spaces.
 - e. Out-of-the-way with maximum passageway and headroom remaining in each space. In spaces without ceilings, mechanical systems are to be installed tight to the underside of structure. Sloping pipe runs must originate tight to structure to allow for maximum installed height throughout.
2. Except as otherwise indicated, arrange mechanical services and overhead equipment with a minimum of:
 - a. 7'0" headroom in storage spaces.
 - b. 8'6" headroom in other spaces, where approved by Architect.
3. Do not obstruct windows, doors or other openings.
4. Give the right-of-way to piping systems required to slope for drainage (over other service lines and ductwork).

G. Access:

1. Provide for removal, without damage to other parts, of:
 - a. Coils
 - b. Humidifier manifolds
 - c. Tubes
 - d. Shafts
 - e. Fan wheels
 - f. Drives
 - g. Filters

- h. Strainers
 - i. Bearings
 - j. Control components
 - k. Other parts requiring periodic replacement or maintenance
- 2. Connect equipment for ease of disconnecting with minimum of interference with other work.
- 3. Provide unions where required.
- 4. Locate operating and control equipment and devices for each access.
- 5. Provide access panels where units are concealed by non-accessible finishes and similar work. See Section 23 05 03.
- 6. Extend all grease fittings to an accessible location.

3.3 PROTECTION OF WORK

- A. All pipe ends, valves, ducts, and equipment left unconnected shall be capped, plugged or otherwise properly protected to prevent damage or the intrusion of foreign matter.
- B. Do not allow any fans in the HVAC system to operate before the area served by the fan has been cleaned and vacuumed of all debris and dust which might enter the system.
- C. Any equipment, duct or piping systems found to have been damaged or contaminated above “MILL” or “SHOP” conditions shall be replaced or cleaned to the Engineer’s satisfaction.
- D. Initial fill of traps:
 - 1. Provide initial water seal fill for all waste P-traps, condensate traps, or similar traps.

3.4 PROTECTION OF POTABLE WATER SYSTEMS

- A. All temporary water connections shall be made with an approved back flow preventer.
- B. All hose bibs shall have as a minimum, a vacuum breaker, to prevent back flow.
- C. Direct connections to hydronic systems shall only be made through a reduced pressure back flow preventer.

3.5 PROTECTION OF SYSTEMS SERVING OCCUPIED SPACES

- A. Where work is being performed in occupied spaces, or occupancy is to be phased in with ongoing construction, contractor shall prevent contamination of all systems serving the occupants including but not limited to:
 - 1. Supply or Return Air
 - a. Systems shall be capped or provided with adequate particulate and gas phase filtration to prevent dust, chemical, or biological contamination. Particulate filters shall be as a minimum equivalent to those specified for the completed system.

2. Domestic Water
 - a. Isolate sterilized portions from non-sterilized portions.

3.6 ASBESTOS

- A. The identification and/or abatement of asbestos hazards is not part of this contract.
 1. If asbestos is encountered, contact Owner for instructions.

3.7 PROJECT CLOSEOUT

- A. Refer to the individual sections of the specifications for individual closeout requirements.
- B. Provide a written schedule of when systems are to be started up, tested and demonstrated along with dates for completion of the temperature controls and balancing. This schedule shall be submitted no later than 30 days prior to starting up and testing equipment.
- C. The contractor shall notify the Architect/Engineer no later than 2 weeks in advance of system testing or demonstration.

END OF SECTION 23 05 02

SECTION 23 05 03 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. This Section supplements Division 1, General Requirements.
- B. Where contradictions occur between this Section and Division 1, the more stringent of the two shall apply. The design team shall decide which is more stringent.
- C. Provisions of this Section shall also apply to all Sections of Divisions 21 through 23.

1.2 SUMMARY

- A. Furnish and install complete electric heat tracing systems as specified herein and as indicated on the mechanical and plumbing drawings. Heat Trace systems shall be installed to maintain the product UL listing with strict conformance to manufacturer's installation requirements.
- B. The Division 23 contractor shall be responsible for fully functional and complete heat trace systems. Refer to specification section 23 05 01 Mechanical and Electrical Coordination for heat trace system scope responsibility.

1.3 SUBMITTALS

- A. Manufacturer's Data - Submit manufacturer's data for:
 - 1. Access panels.
 - 2. Fire stopping materials.
 - a. Application Data - Submit application data for firestopping materials showing UL required installation details for every combination of pipe material, penetrated structure, opening size and required fire rating within the scope of this project. Application data drawings shall include UL system number.

PART 2 - PRODUCTS

2.1 ACCESS PANELS

- A. See Division 8 for access panel types and finishes.
 - 1. If panels are not specified in Division 8, comply with the following:
 - a. Manufacturers:
 - 1) Acudor
 - 2) Karp Associates, Inc.

- 3) Milcor
- 4) Zurn.

B. Construction:

- 1. Doors: 14-gauge steel.
- 2. Frames: 16-gauge steel.
- 3. Fire Rating: Equivalent to construction in which installed.
- 4. Latches: Flush or concealed, $\frac{1}{4}$ turn.
- 5. Finish: Compatible with finish of construction in which installed.

2.2 FIRE STOPPING MATERIAL

A. Manufacturers:

- 1. Design Basis: 3M.
- 2. Other acceptable manufacturers:
 - a. Dow
 - b. GE
 - c. Hilti
 - d. Metalines

B. General Requirements:

- 1. Products to be used shall have been tested in accordance with ASTM E 814-88, and be listed in the UL Fire Resistance Directory.

C. Bare Piping:

- 1. Model: FD 150, or CP-25.

D. Insulated Piping:

- 1. Model: CP-25 or FS-195, Intumescent.
- 2. "No-sag" or "self-leveling" as required.

E. Accessories:

- 1. Provide fasteners, restricting collars, backing materials, and protective coatings as required to comply with the UL system listing.

2.3 ACOUSTICAL/PRESSURE SEALING MATERIAL

A. Manufacturers:

- 1. Manufacturers:
 - a. D.A.P. Mono Acoustical Sealant
 - b. GE

- c. Metacaulk
- d. Hilti
- e. Pecora
- f. Tremco
- g. U.S.G.

B. General Requirements:

- 1. Non-skinning, non-hardening synthetic butyl rubber.
- 2. Effective adhesive seal for air and vapor barrier.
- 3. Acceptable for use in air plenums.

C. Accessories:

- 1. Provide fasteners and backing rods as recommended by manufacturer.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

A. Refer to Division 1 of the Specifications.

B. General: Provide measurements, drawings and layouts to installers of other work so that required openings may be provided as construction progresses. Any cutting and patching made necessary by failure to provide this information shall be done at no increase in the contract amount.

C. General: All cutting and patching of existing work required for work of Divisions 21 through 23 is included in Divisions 21 through 23.

D. Where possible, mark openings to be cut on existing construction. Otherwise, provide measurements, drawings and layouts to the trade doing the cutting so that openings may be provided as construction progresses.

E. Cutting Concrete:

- 1. Where authorized, cut openings through concrete for pipe penetration and similar services by core drilling or sawing.
- 2. Do not cut by hammer-driven chisel or drill.

F. Cutting:

- 1. Cut openings in accordance with layouts, measurements, or drawings of the Installer of work requiring openings. Cut openings in concrete by core drilling or sawing; not by hammer-driven chisel or drill.
- 2. Coordinate the location of all openings with structural drawings. Report any discrepancies to Architect. Do not proceed with work until discrepancies have been resolved.

3. Do not endanger or damage other work through the procedures and processes of cutting to accommodate mechanical work.
4. Review the proposed cutting with the Installer of the work to be cut and comply with their recommendations to minimize damage.
5. Where necessary, engage the original Installer or other specialists to execute the cutting in the recommended manner.

G. Patching:

1. Where patching is required to restore other work because of either cutting or other damage inflicted during the installation of mechanical work, engage experienced craftsmen to complete the patching of the other work.
2. Restore the other work in every respect, including the elimination of visual defects in exposed finishes.
3. All openings in fire rated construction shall be patched and sealed with U.L. approved sealant to maintain the fire integrity of the structure.

H. Perform cutting, and patching required to:

1. Uncover work to provide installation of ill-timed work.
2. Remove and replace defective work.
3. Remove and replace work not conforming to requirements of the Contract Documents.
4. Remove samples of installed work as specified for testing.
5. Install equipment and materials in existing structures.
6. Upon written instructions from the Architect/Engineer, uncover and restore work to provide for Architect/Engineers observation of concealed work.

I. Painting: Paint all surfaces marred by cutting and/or patching to match existing.

1. Engage experienced painters.
2. Comply with requirements of Painting Sections of this Specification.

J. Structural Limitations:

1. Do not cut or drill into structural framing, walls, floors, decks, and other members intended to withstand stress, except with Engineer's written authorization.
 - a. Provide lintels, columns, braces and other temporary and permanent supports made by cutting.
 - b. Submit shop drawings of permanent supports.
 - c. Do not penetrate legs of structural "T's" or any other location where pre-stressed structural chords are likely to be encountered when cutting or drilling.

3.2 ACCESS PANELS

A. Furnish access panels where indicated and at locations where required for access to:

1. Concealed valves
2. Dampers
3. Control devices

4. Equipment servicing
5. Shock arresters
6. Air vents
7. Flow measuring and balancing stations
8. Any other device or item equipment requiring maintenance, adjustment or service.

- B. Deliver access panels for installation by the trade responsible for surface in which installed.
1. Provide instructions for location.
 2. Access doors shall be sized as required to allow equipment removal, with a minimum size of 12"x12".

3.3 SLEEVES

- A. Provide sleeves for piping passing through walls, floors and roofs.
- B. Set pipe sleeves and inserts in place before concrete is poured. Coordinate the placing of these items to avoid delaying concrete placing operations.
- C. Locate chases, shafts, and openings required for the installation of the mechanical work during framing of the structure. Do any additional cutting and boring required due to improperly located or omitted openings without cost to the Owner under the supervision of the Owner's representative.
- D. Size sleeves for below grade pipe a minimum of 2" beyond outside of pipe.
- E. Provide Sleeves as Follows:

<u>Sleeve Location</u>	<u>Sleeve Material</u>
Interior Stud Partition Walls	Adjustable galvanized sheet metal with wall flanges and plaster lip, 2" and smaller – 22 gauge, 3" through 6" – 20 gauge, 8" and larger – 18 gauge.
Membrane Waterproof Floor and Roof Construction	Galvanized cast iron body with flashing clamp, threaded for sleeve riser. (J.R. Smith 1760 or equivalent by Ancon, Zurn or Josam).
Nonmembrane Floor, Construction	Non-adjustable galvanized sheet metal with deck flange and end cap, 2" and smaller – 22 gauge, 3" – 20 gauge, 4" and larger – 16 gauge.
Exterior Walls Below Grade	Standard weight galvanized steel pipe with a continuously welded water stop of 1/4" steel plate extending from outside of sleeve a minimum of 2" all around. Provide modular mechanical-type seal consisting of interlocking synthetic rubber links with bolts shaped to continuously fill the annular space between the pipe and sleeve. Thunderline Corporation "Link-Seal" sealant assembly or equal by Metraflex "MetaSeal".
Floors of Mechanical Rooms, Concrete Walls or Masonry Walls Above Grade.	Standard weight galvanized steel pipe.

F. Length of Sleeves as Follows:

<u>Location</u>	<u>Sleeve Length</u>
Floors	Equal to depth of floor construction including finish. Extend minimum of 1" above finished floor level within partitions, mechanical rooms, pipe chases and finished areas.
Roofs	Equal to depth of roof construction including insulation.
Walls	Equal to depth of construction.

3.4 FIRE STOPPING

- A. Install firestopping materials in accordance with their UL and ASTM tested methods.
- B. Coordinate required annular space with size of pipe and sleeve. Refer to Section 23 05 22.
- C. Requirements for specific systems:
 - 1. Cold piping - includes chilled water, domestic water, storm water and refrigerant: Insulation and vapor barrier shall be continued through the penetration and firestopping for "insulated piping" shall be provided.
 - 2. Hot piping - to 250°F -includes domestic hot water, steam to 15 psig and heating hot water: The Contractor has the option of continuing the insulation through the penetration and providing firestopping for "insulated piping", or stopping the insulation on either side of the penetration and using firestopping for "uninsulated piping".
 - 3. High temperature piping, over 250°F or over 15 psig steam: Contractor shall stop insulation and provide firestopping for "high temperature piping".

3.5 DRIP PANS

- A. Drip Pans: Where possible to run mechanical piping elsewhere, do not run mechanical piping directly above electrical (or electronic) work which is sensitive to moisture. Otherwise, provide drip pans under mechanical piping, sufficient to protect electrical work from dripping.
 - 1. Locate pan immediately below piping, and extend a minimum of 6" on each side of piping and lengthwise 18" beyond equipment being protected.
 - 2. Fabricate pans 2" deep of reinforced sheet metal with rolled edges and soldered or welded seams; 22-gauge galvanized steel.
 - 3. Provide 3/4" copper drainage piping from pan to nearest floor drain or similar suitable point of discharge, and terminate pipe as an open-sight drainage connection.
 - 4. Provide permanent support and anchorage to prevent displacement of drip pans.
 - 5. Insulate bottom of pan as directed by Engineer.

END OF SECTION 23 05 03

SECTION 23 05 21 - PIPE AND PIPE FITTINGS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

- A. Welder Qualifications: Welders, both on-site and off-site, shall be certified for the type of work being performed by one of the following:
 - 1. National Certified Pipe Welding Bureau.
 - 2. Intermountain Testing Company
- B. Welder Certificates:
 - 1. Submit one copy of certificate to Architect/Engineer.
 - 2. Maintain one copy on project site.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. Refer to the following sections:
 - 1. 21 13 00 - Fire Protection
 - 2. 22 10 00 - Plumbing Piping
 - 3. Other Divisions 21 through 23 sections after specific system requirements.

2.2 GROOVED PIPE COUPLING SYSTEMS

- A. Manufacturers of Coupling System:
 - 1. Basis of Design: Victaulic
 - 2. Other Acceptable Manufacturers: Grinnell and Grevlok. Alternate is to provide a system of standard weight black steel pipe with black steel standard weight butt weld or 125 lb. cast iron flanged fittings.
 - 3. All couplings, gaskets and joining method adapters shall be provided by one manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
 - 4. Training: A factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and product installation.

B. Dimensional Standards:

1. All grooved pipe fittings, couplings, and specialties shall conform to standard dimensional standards ANSI/ANWA C-606 or MIL-P-11087C.

C. Acceptable Products:

1. Only the following grooved pipe products may be used:
 - a. Gaskets: (ASTM D2000)
 - 1) EHP, for water service, with or without propylene glycol -30°F to 250°F.
 - 2) E, for water service, with or without propylene glycol -30°F to 230°F. 14" and larger shall be FlushSeal® wide-width gaskets.
 - b. Couplings - Steel Pipe: Ductile iron (ASTM A-536), with enamel paint coating.
 - 1) Rigid Couplings: Style 107V, 07, W07 zero flex.
 - a) 107V housings cast with torque-absorber and shift-limiting slant bolt pad in accordance with ANSI B31.1 and B31.9. Housings cast with alignment indicator notch to aid alignment.
 - 2) Flexible Couplings: Style 177, 77, W77.
 - c. Flange Adapters: Same materials as couplings. Provide for rigid connection to grooved pipe. Provide flange washers and/or flange gaskets as required for mating to non-standard flanges, such as butterfly valves with elastomeric face, or serrated face flanges.
 - 1) ANSI Class 125 or 150: Style 741 and W741.
 - 2) ANSI Class 300: Style 743.
 - 3) Alternate to flange adapter: Flange by groove nipple #41 (Class 125), #45 (Class 150), #16 (Class 300).
 - d. Branch Outlet Couplings: Design similar to coupling with integral side outlet.
 - 1) Victaulic Style 920 / 920N.
 - e. Fittings for steel pipe: Standard pattern fittings, ductile iron (ASTM A-536) or segmentally, factory welded Schedule 40 steel (ASTM A-53) with enamel paint coating. All changes in direction greater than 22° shall be with R=1.5D radius elbow. All branches and changes in direction in drainage piping shall be made with sanitary type lateral branches and R=1.5D elbows.
 - 1) 2" through 12" ASTM A536 Grade 65-45-12 ductile iron with Victaulic Original Grooved System (OGS) grooved ends, stiffening ribs, and alignment indicators, orange coated or hot dipped galvanized as per ASTM A123, working pressure 400-psi. Victaulic QuickVic™ V10 (90-deg), V11 (45-deg), and V20 (tee).
 - f. Accessories: Other piping accessories such as strainers, suction diffusers and flow indicators may be provided with grooved ends, all such accessories shall comply with the applicable specification section.
2. All other pipe products shall conform to the requirements of other Divisions 21 through 23 sections. Acceptance of grooved pipe systems does not imply acceptance of the coupling manufactures valves, branch outlets, strainers, or other specialties.

2.3 PRESS FIT JOINING SYSTEM

A. Manufacturer

1. Merit Brass CopperPress
2. Nibco Press System
3. Victaulic VicPress
4. Viega ProPress
5. Other approved manufacturer

B. Material

1. Press Fittings:
 - a. Copper press fittings.
 - b. Precision, cold drawn, stainless steel (Option for sizes 2" and smaller).
2. O-Rings: EPDM
3. Fittings shall be rated for 0°F to 250°F, and 200 psi.
4. Fittings must comply with ASME B16.51 and ASTM F3226. Provide ICC or IAPMO certificate of listing or 3rd party testing.

C. Application

1. Domestic Water, 4" and smaller

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

A. General:

1. Install pipe, tube and fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing each indicated service without piping failure.
2. Install each run with a minimum of joints and couplings, but with adequate and accessible unions for disassembly, maintenance or replacement of valves and equipment.
3. Reduce sizes by use of reducing fittings.
4. Install piping without springing or forcing.
5. Provide sufficient swing joints, anchors, expansion loops and devices necessary to permit free expansion and contraction without causing undue stresses.
6. Support piping independently at equipment so its weight will not be supported by the equipment.
7. Support piping to maintain a consistent slope as indicated on the drawings without sagging or pocketing of any kind. Where not otherwise indicated, all horizontal piping shall slope a minimum of 1/16 inch per foot to drain at system low points.
8. Provide manual air vents at high points of all pumped piping systems. Provide drains at all low points.

9. Install horizontal piping parallel to building construction, make any changes in direction with fittings.

B. Location:

1. Locate piping runs, except as otherwise indicated, both vertically and horizontally to allow for complete drainage of piping system (pitched to drain).
 - a. Avoid diagonal runs wherever possible.
 - b. Orient horizontal runs parallel with walls and column lines.
2. Hold piping close to walls, overhead construction, columns and other structural and permanent-enclosure elements of the building.
 - a. Limit clearance to 0.5" where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any.
 - b. Where possible, locate insulated piping for 1.0" clearance outside insulation.
3. Wherever possible in finished and occupied spaces, conceal piping from view by locating in column enclosures, in hollow wall construction or above suspended ceilings.
 - a. Do not encase horizontal runs in solid partitions, except as otherwise indicated.

C. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures.

1. Exception: where shown on drawings or where accepted by the Engineer, provide drip pan under piping, and conform to NEC.
2. In no case shall piping run directly above transformers, electrical panels or switchgear.

D. Dielectric Unions: Install dielectric unions to prevent galvanic action between ferrous and non-ferrous piping.

1. Install in an accessible location or provide access doors.

3.2 WELDING

A. Welding:

1. Conform to Code for Pressure Piping ANSI B31.
2. Machine cut and bevel piping ends for v-type joints.
3. Use recommended bevels and spacing between ends of pipe to assure full penetration complete to inside diameter of pipe.

B. Welded Joints:

1. Will be observed visually by the Architect/Engineer.
2. Any weld judged defective from a visual observation, shall be ordered tested at the expense of the Contractor or chipped out for full depth and re-welded.

C. Welding Fittings:

1. Unless otherwise noted, make all changes in direction and branch take offs with manufactured fittings.
 - a. Use long radius ($R=1.50$) fittings wherever possible.
2. Shop Fabricated Fittings:
 - a. Branches more than two pipe sizes smaller than main line may be made with “weld-o-let” type pre-manufactured saddle fittings.
 - b. Where specifically allowed by the Engineer, angles of less than $22\frac{1}{2}^\circ$ and branch piping from headers may be made by shop fabricated or manufactured mitered fittings.
 - c. Submit shop drawings.
 - d. Thoroughly clean fittings to remove slag.
 - e. Fittings shall be available for observation by the engineer prior to installation.
3. In no case will field made miters or weld-o-let fittings be allowed. Exception:
Temperature control wells and water treatment taps may be made with weld-o-let fittings in pipe 3” or larger in diameter.

3.3 COPPER TUBING JOINTS AND FITTINGS

- A. Unless otherwise noted, make all couplings, changes in direction, branch outlets, and transitions to other materials or joining methods with standard manufactured fittings.
- B. Do not expand or swage piping in lieu of proper solder fittings.
- C. Do not extrude or “pull” branch outlets with “tee-drill” type equipment.
- D. Do not use self-tapping type branch outlets.
 1. See “hot taps” below.

3.4 THREADED JOINTS AND FITTINGS

- A. All threaded joints shall be made in accordance with American National Standard B2.1.
 1. Do not overthread pipe.
 2. Apply pipe joint compound on male threads only.
 3. Do not use right and left hand threaded joints to make a “union”.
- B. Do not thread steel pipe schedule 10 or lighter.
 1. UL listed light wall pipe may be threaded in accordance with its listing.

3.5 MECHANICAL COUPLING SYSTEMS

- A. All changes in direction shall be made with radius type elbows.
 - 1. Use long radius ($R=1.5D$) fittings wherever possible.
 - 2. Angles less than $22\frac{1}{2}^\circ$ may be made with pre-manufactured mitered fittings.
 - 3. Use of the angular deflection capabilities of grooved pipe couplings for intentional changes of direction shall not be allowed.
- B. All branch outlets shall be made with pre-manufactured 3-way fittings.
 - 1. Shop fabricated Weld-o-let style welded saddle fittings may be used for branches more than two pipe sizes smaller than the main.
 - 2. Mechanical saddle tap fittings shall not be allowed.
- C. Pipe shall be adequately laterally supported to prevent "pipe squirm". Provide a minimum of one hanger per pipe section. No pipe section shall be left unsupported between any two couplings.
 - 1. Rigid type couplings may be considered equivalent to welded or soldered pipe for the above requirements.
- D. Risers more than 20' high shall be made with rigid type couplings.
- E. Grooved joints shall be installed in accordance with the manufacturer's latest published instructions.
- F. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service. Gaskets shall be molded and produced by the grooved coupling manufacturer. No high temperature lubricant shall be needed to achieve gasket service temperatures. Utilize center-leg gaskets with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth.
- G. Grooved coupling manufacturer's factory trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products.
- H. The factory trained representative shall periodically visit the jobsite to ensure best practices in grooved product installation are being followed. Contractor shall remove and replace any improperly installed products.
- I. Grooved pipe systems shall not be considered to be electrically conductive.
 - 1. Provide wire jumpers across all couplings where the piping system is required to be electrically conductive.
 - 2. Cold water piping using grooved pipe systems shall not be used for building ground.
 - a. Provide an engraved plastic sign at the building water entrance stating, "Mechanical Coupling System". Not Electrically Conductive".

- J. Flexible couplings may be used for thermal expansion/contraction compensation.
 - 1. Use a minimum of 1 flexible coupling for every 100 feet domestic cold-water piping.
 - 2. Use a minimum of 1 flexible coupling for every 50 feet domestic hot-water piping.
 - 3. The above is for cut grooved pipe. Double the amount of the connectors with roll grooved pipe and fittings.

3.6 PRESS FIT SYSTEMS

- A. Fittings and piping shall be joined in accordance with manufacturer's installation guidelines.
 - 1. Tubing shall be fully inserted into fitting.
 - 2. Mark all tubes at shoulder of fitting.
 - 3. Press joints using manufacturer approved tool.

3.7 HOT TAPS

- A. Installing a branch line in piping while under service or static pressure (hot taps) shall only be done where specifically authorized.
- B. Submit the proposed method of procedure for each fluid service and pipe material.
 - 1. Hot tap procedure shall remove a plug of main tap material and retrieve it. The plug shall be a maximum of 1 pipe size smaller than the branch size. Hang the removed plug by a chain at the completed tap.
 - 2. Hot tap procedure shall not affect the temperature or pressure rating of the piping system.
 - 3. Hot tap procedure shall be done through a gate or ball valve.

3.8 SENSOR WELL TAPS

- A. Sensor wells shall be placed in taps made in accordance with the above requirements for branch outlets.

3.9 CLEANING, FLUSHING, INSPECTING

- A. Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings, if any.
- B. Flush out water and piping systems with clean water before proceeding with required tests.
- C. See specific pipe service section for further requirements.

3.10 PIPING TESTS

- A. Provide temporary equipment for testing, including pump, thermometer and gauges.

- B. Test piping system after initial flush, before insulation is installed wherever feasible, and after control devices have been removed.
- C. Do not use air pressure to test plastic pipe.
- D. Test each natural section of each piping system independently, but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating.
- E. Fill each section of water, drain or vent piping with water and pressurize for two hours at 150% of operating pressure, but not less than 25 psig for pressure piping, and ten feet of head for drain and vent piping.
- F. Test fails if leakage is observed, or if temperature compensated pressure drop exceeds 1% of test pressure.
- G. Disassemble and re-install sections which fail the test by using new materials to the extent required to overcome leakage.
 - 1. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.
- H. After testing and repair work have been completed, drain test water from piping systems.

3.11 MECHANICALLY FORMED TEE CONNECTIONS (DOMESTIC WATER SYSTEMS ONLY)

- A. Mechanically extracted collars shall be formed in a continuous operation consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a height of not less than three times the thickness of the branch tube wall so as to comply with the American Welding Society lap joint weld. The collaring device shall be fully adjustable as to ensure proper tolerance and complete uniformity of the joint.
- B. The branch tube shall be notched to conform with the inner curve of the run tube and have two dimple/depth stops (one 1/4" atop the other) to ensure penetration of the branch tube into the collar is of sufficient depth for brazing, and that the branch tube does not obstruct the flow in the main line tube. Dimple/depth stops will be in line with the run of the tube. The second dimple shall be 1/4" above the first and will serve as a visual point of inspection.
- C. All joints shall be brazed in accordance with the Copper Development Association Copper Tube Handbook using BCuP series filler metal. NOTE: Soft soldered joints will not be permitted. Contractor assumes responsibility for joints being installed in accordance with code and manufacturer's recommendation.
- D. All mechanically formed branch collars shall be listed by the Standard Plumbing Code, I.A.M.P.O., S.B.C.C. HUD, U.S. Army Corps of Engineers, NAVFAC, and Underwriters Laboratory. They shall also comply with the ASME Code for pressure Piping ANSI B31.5c.

3.12 PAINTING

- A. Exposed piping shall be painted. Pipe shall be cleaned by this contractor and ready for priming and painting.

END OF SECTION 23 05 21

SECTION 23 05 22 - PIPING ACCESSORIES

PART 1 - GENERAL

1.1 SUBMITTALS

- A. Manufacturer's Data - Piping Accessories: Submit manufacturer's data on the following piping accessories:
 - 1. Sealing compound for sleeves.
 - 2. Expansion compensators.
 - 3. Flexible pipe connections.
 - 4. Guides.

PART 2 - PRODUCTS

2.1 MANUFACTURED PRODUCTS

- A. Escutcheon Plates:
 - 1. Type: Split ring
 - 2. Construction: Brass
 - 3. Finish:
 - a. At Painted Surfaces: Prime coat
 - b. At Other Surfaces: Nickel or Chrome plate
 - 4. For Floor Sleeves: Where sleeves extend above floor surface, provide depth to cover sleeve.
- B. Flexible Pipe Connectors, Rubber Type:
 - 1. Manufacturers - Design Basis: Mason
 - 2. Other Acceptable Manufacturers:
 - a. Flexicraft
 - b. Keflex
 - c. Metraflex
 - 3. Material: Two sphere EPDM construction with reinforcing ring.
 - 4. Model: MFTNC, Twin Sphere 225 psi.
- C. Flexible Pipe Connectors, Braided Hose:
 - 1. Manufacturers - Design Basis: Mason
 - 2. Other Acceptable Manufacturers:
 - a. Flexicraft

- b. Keflex
 - c. Metraflex
3. Material: Stainless steel braid with carbon steel connectors, threaded or flanged.

2.2 FABRICATED ACCESSORIES

- A. Steel-Pipe Sleeves: Fabricate from Schedule 40 steel pipe. Remove burrs.
- B. Iron-Pipe Sleeves: Fabricate from service weight cast-iron pipe. Remove burrs.
- C. Sheet-Metal Pipe Sleeves: Fabricate from galvanized sheet-metal, closed with lock-seam joints. Provide gauge in accordance with section 23 05 03.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Pipe Sleeves:
 - 1. Install pipe sleeves where piping passes through walls, floors, ceilings, roofs and structural members, except soil pipe penetrations through concrete slab on grade.
 - 2. Where possible pour sleeve in place or grout.
 - 3. Provide sleeves of adequate size, accurately centered on pipe runs, so that piping and insulation (if any) will have free movement in the sleeve in non-fire rated penetrations.
 - 4. In fire rated penetrations, size sleeves such that the resulting annular space is in accordance with the application requirements of the fire stopping system. Refer to Section 23 05 03. All above grade floor penetrations shall be considered to be fire-rated.
 - 5. Install length of sleeve equal to thickness of construction penetrated, except extend floor sleeves 0.25" above floor finish and, where floor surface drains to a floor drain, extend floor sleeve 0.75" above floor finish.
 - 6. Provide temporary support of sleeves during placement of concrete and other work around sleeves.
 - 7. Provide temporary closure to prevent concrete and other materials from entering pipe sleeves.
 - 8. Except as otherwise indicated, install steel pipe sleeves.
 - 9. At interior partitions and ceiling, install sheet metal sleeves.
 - 10. At exterior penetrations below grade, install iron pipe sleeves.
 - 11. Seal exterior sleeve penetrations at grade weather tight.
- B. Caulking:
 - 1. Where water seal or sound seal, but not fire seal, is needed, (foundation walls, slab on grade): fiberglass backing and heavy bead of silicone caulking compound.
 - 2. Where sleeve pierces a fire separation: Fire stop material in accordance with manufacturer's directions and UL listing. Refer to Section 23 05 03.

- C. Install escutcheon plates at pipe sleeves where piping is exposed to view in occupied spaces of the building, on the exterior, and elsewhere as indicated.
- D. Compensators: Install where shown or where required because piping arrangement does not provide sufficient flexibility.
 - 1. Protect compensators from over-travel and over-stress during remaining installation and testing.
- E. Flexible Connectors: Install at right angles to displacement.
 - 1. Install one end immediately adjacent to isolated equipment and anchor other end.
- F. Guides: Install where shown and where required in accordance with expansion compensators published requirements.
 - 1. As a minimum, install one guide within four pipe diameters of compensator, and one guide 14 pipe diameters from first guide.

END OF SECTION 23 05 22

SECTION 23 05 23 - VALVES

PART 1 - GENERAL

1.1 SUBMITTALS

- A. Manufacturer's Data: Submit manufacturer's product data including:
1. Dimensions
 2. Sizes
 3. End Connections
 4. Weights
 5. Installation instructions
 6. Instructions on repacking and repairing valves.
 7. Range of flow and full open (permanent) pressure loss for balancing valves and plug valves.
 8. Differential pressure tables for flow measurement at venturi type balancing valves.
- B. Valve Tag List: Refer to Section 23 05 53 of the Specifications.

PART 2 - PRODUCTS

2.1 VALVE TYPES AND SIZES

- A. General:
1. Where type or body material is not indicated, provide valve with pressure class selected from MSS or ANSI standards, based on the maximum pressure and temperature in the piping system.
 2. All valves in contact with domestic water shall meet the requirements of NSF/ANSI Standards 61 and 372.
 3. Except for balancing or otherwise indicated, provide valve of same size as connecting pipe size.
 4. Ball valves or butterfly valves may be used in lieu of gate valves when pressure and temperature ratings are adequate.
 5. Where pipe sizes overlap, contractor has the option of threaded or flanged valves.
 6. Where grooved pipe mechanical coupling systems are accepted, provide flange adapters to mate with valves as specified below. Valves by the mechanical coupling system manufacturer shall not be used unless they meet all of the specified requirements for a given valve.
 7. All valves shall be domestically manufactured unless approved for use by Engineer.
 8. Valves used for domestic water service shall be bronze or stainless steel. Iron and brass body valves are not acceptable.
 9. All components in hydronic systems shall be compatible with propylene glycol and water solution.

- B. Unless noted otherwise, the following table indicates valve types to be used for functions listed. Manufacturer listed is basis of design. Refer to specification section indicated for additional requirements.

Service	Domestic Hot and Cold Water
Shutoff/ Isolation	All sizes • Type BV Ball RE: 221000 Plumbing Piping
Check	2" and larger: • Type SWCV Silent/Wafer Check 1-1/2" and smaller: • Type SCV Swing Check RE: 221000 Plumbing Piping
Balance	All sizes • Type CS Circuit Setter RE: 221000 Plumbing Piping
Base Mounted Pump Discharge	N/A
Inline Pump Discharge	All sizes: • Type SWCV Silent/Wafer Check
Drain Valve	All sizes: • Type BV Ball
Bypass	RE: Shutoff/Isolation RE: 221000 Plumbing Piping

1. Refer to section 22 10 00 Plumbing Piping for additional Domestic Water valve specifications and requirements.
2. Refer to Division 22 specifications for additional system valves and specialties not indicated in table above.

2.2 GLOBE AND ANGLE VALVES – TYPE GAV

A. Manufacturers:

1. Design Basis: Milwaukee
2. Other Acceptable Manufacturers:
 - a. Crane
 - b. Gruvlok
 - c. Nibco
 - d. Powell
 - e. Stockham
 - f. Victaulic (for Grooved Pipe Systems)

- B. Size 2" and Smaller: Bronze, 125 psi SWP, 200 psi WOG, rising stem, screwed bonnet. Bronze disk, MSS SP-80, Type 1.

1. Model:
 - a. Globe, Solder Ends: 1502
 - b. Globe, Threaded Ends: 502
 - c. Angle: 504

2.3 SWING CHECK VALVES – TYPE SCV

- A. Manufacturers:
 - 1. Design Basis: Milwaukee
 - 2. Other Acceptable Manufacturers:
 - a. Crane
 - b. Gruvlock
 - c. Nibco
 - d. Powell
 - e. Stockham
 - f. Victaulic (for Grooved Pipe Systems)
- B. Size 2" and Smaller: Bronze, 200 psi SWP, 400 psi WOG, straight or Y-pattern, Bronze Disk, MSS-SP80 Type 3.
 - 1. Model: 508
- C. Valves used for domestic water service shall be ANSI/NSF-61/372 certified.

2.4 SILENT/WAFER CHECK VALVES – TYPE SWCV

- A. Manufacturers:
 - 1. Design Basis: Metra Flex
 - 2. Other Acceptable Manufacturers:
 - a. Cla-Val
 - b. GA Industries
 - c. Gruvlok
 - d. Nibco
 - e. Stockham
 - f. Tyco
 - g. Victaulic (for Grooved Pipe Systems)
- B. Size 2" and Smaller: Bronze body, 200 psi @ 250 °F, threaded ends, resilient seats, center guided disk.
 - 1. Model: 5700
- C. Pipe size 2-1/2" and Larger: Iron body, bronze or stainless-steel trim, class 125, 316 stainless-steel spring, dual plate or tilting disk type, resilient seat, minimum C_v: 4"-280, 8"-1200, 12"-4000.
 - 1. Model: 810
- D. Valves used for domestic water service shall be ANSI/NSF-61/372 certified.

2.5 BUTTERFLY VALVES – TYPE BTV

A. Manufacturers:

1. Design Basis: Keystone
2. Other Acceptable Manufacturers:
 - a. Bray
 - b. Center Line
 - c. Crane
 - d. Gruvlok
 - e. Hammond Watts
 - f. Keystone
 - g. Milwaukee
 - h. Nibco
 - i. Stockham
 - j. Victaulic (for Grooved Pipe Systems)

- B. Water Service (less than 250°F): 200 psi WOG, cast or ductile iron fully lugged body, integral extended neck to clear insulation, integral top plate for actuator mounting, stainless-steel stem, upper and lower lubricated bushings, field replaceable hard back seat with integral stem and flange seals, machined disk seating areas, rated for minimum 150 psi dead end service with no downstream flange. Liner to be compatible with operating fluid. Conform to MSS-SP67.

1. Disk Material - 8" and Under and all sizes for condenser or domestic water: Aluminum bronze.
2. Disk Material, 10" and Larger: Nickel plated ductile iron.
3. Model: Figure 2-22.

C. Accessories:

1. 10 position locking lever handle for valves 6" and smaller.
2. Infinite position memory stop lever handle for all valves 6" and smaller used for balancing.
3. Hand wheel gear operator for valves 8" and larger.
4. Chain wheel operator where required.

- D. Valves used for domestic water service shall be ANSI/NSF-61/372 certified.

2.6 BALL VALVES – TYPE BV

A. Manufacturers:

1. Design Basis: Nibco
2. Other Acceptable Manufacturers:
 - a. Apollo
 - b. Bray
 - c. Dyna Quip
 - d. Gruvlok
 - e. Hammond

- f. Milwaukee
 - g. Stockham
 - h. Victaulic (for Grooved Pipe Systems)
 - i. Watts
- B. Valve bodies must be cast bronze. Forged brass is not acceptable.
- C. Bronze, 150, SWP, 600 WOG (min), chrome plated solid, tunneled bronze ball (stainless for steam service), two-piece design, blow-out proof stem, adjustable packing gland nut (allowing handle to be removed without leaking) TFE seats, MSS-SP-110.
 - 1. Model: T-585-70 - full.port.
- D. Valves used for domestic water service shall be ANSI/NSF-61/372 certified.
- E. Options: Provide the following where required:
 - 1. Extended stems for insulated valves.
 - 2. Memory stop device for balancing applications.
 - 3. Tee handle for tighter areas.
 - 4. Hose end and cap for drain.
 - 5. Mounting pads for actuator.
 - 6. Bleed port.

2.7 CIRCUIT SETTERS (CS) – DOMESTIC WATER APPLICATIONS ONLY – TYPE CS

- A. Manufacturers:
 - 1. Design Basis
 - a. Bell & Gossett/ITT
 - 2. Acceptable Manufactures:
 - a. Victaulic
 - b. Prior Engineer Approval for Substitutions
- B. Construction:
 - 1. All valves to be of brass body/brass ball construction with glass and carbon-filled TFE seat rings. Valves to have differential pressure read-out ports across valve seat area. Read-out ports to be fitted with internal EPT insert and check valve. Valve bodies to have ¼" NPT tapped drain/purge port. Valves to have memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. All valves to have calibrated nameplate to assure specific valve setting. Valves to be leak-tight at full rated working pressure.
- C. Valves ½" to 2" pipe size, NPT or sweat valves 2 ½" and 3" pipe size, NPT.

- D. Pressure/Temperature 175 psig at 250°F.
- E. ANSI/NSF-61/372 certified.

2.8 DRAIN VALVES – TYPE DV

- A. Ball valve with hose end adapter and cap.

2.9 PLUG VALVES – TYPE PV

- A. Manufacturers:
 - 1. Design Basis: Keystone
 - 2. Other Acceptable Manufacturers:
 - a. Dezurik
 - b. Victaulic (for Grooved Pipe Systems)
- B. Model: “Ballcentric”; cast-iron, full port body; EPDM coated plug; welded nickel seat; stainless-steel bearings; integral memory stop device; hand wheel operator for valves 6” and larger.

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with the following requirements:
 - 1. Install valves except butterfly with stems pointing up, and as close to vertical as possible. Butterfly valves to be offset at least 10° from vertical.
 - 2. Install valves at each piece of equipment, fixture or appliance so that the supply and return services can be shut off to remove the item without draining the remainder of the piping system.
 - 3. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping.
 - a. Locate valves so as to be accessible.
 - 4. Combination balancing and shut-off valves may be used instead of a separate balancing valve and shut-off valve if the valve has a memory stop and the manufacturer lists its use as a leak-proof service valve.
 - 5. Provide drain valves at main shut-off valves, low points of piping and apparatus.
 - 6. Provide separate support where necessary.
 - 7. Do not allow meter connections of balancing valves to point downward.
 - 8. Install valves so bypass valves are accessible.
- B. All valves of a given type shall be of one manufacturer.

- C. Provide extended stems on insulated system to prevent interference of operator with insulation.
- D. Provide chain wheel operators for valves more than 8' – 0" AFF in mechanical rooms and wherever shown on drawings.

3.2 CHECK VALVE INSTALLATION

- A. Swing and Check Valves:
 - 1. Install only in horizontal lines unless absolutely impractical. If installed vertically, flow shall be upwards.
 - 2. Do not install in pump discharge piping.
- B. Silent Check Valves:
 - 1. Silent check valves may be installed in vertical pipes with flow down upon Engineer's review for each instance.

3.3 CIRCUIT SETTERS

- A. All circuit setters shall be installed per manufactures recommendations. Provide manufacturers recommendation for required straight pipe for inlet and outlet connections to provide accurate ratings. Setting shall be 1 GPM unless otherwise noted on drawings.

END OF SECTION 23 05 23

SECTION 23 05 29 - PIPE SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 STANDARDS

- A. ASME B31.1 (American Society of Mechanical Engineers) – Power Piping.
- B. Comply with MSS Standard Practice SP-69, published by Manufacturer's Standardization Society of the Valve and Fitting Industry for type and size.
- C. NFPA 13 (National Fire Protection Association) – Installation of Sprinkler Systems.
- D. UPC/IPC (Uniform/International Plumbing Code) – Defines support spacing of hangers. Refer to Mechanical Legend for applicable code/edition.

1.2 SUBMITTALS

- A. Submit manufacturer's product data on the following:
 - 1. Hangers other than clevis type.
 - 2. Anchors.
- B. Submit structural calculations on trapeze type supports.
- C. Submit product data and calculations in compliance with applicable ICC-ES or IAPMO-UES research report to project structural engineer for review. Submittals shall document compliance with current Building Codes and maximum point loads listed in Structural plans.

PART 2 - PRODUCTS

2.1 PIPE HANGERS

- A. General:
 - 1. Use adjustable pipe hangers on suspended pipe. Trapeze hangers may be used at the Contractor's option. Contractor shall be responsible for sizing supports.
 - 2. Chain, wire or perforated strap hangers will not be permitted.
 - 3. Isolate hangers in contact with dissimilar materials with dielectric hanger liners. Tape is not acceptable.
 - 4. Provide supports between piping and building structure where necessary to prevent swaying.

B. Hanger and Rod Material:

1. Exposed in public areas: Zinc electroplated steel.
2. Concealed or in service areas: Black threaded steel.
3. Outside, exposed to weather: Hot dipped galvanized.
4. Corrosive Environment (e.g., Natatorium): Stainless Steel (316 or Duplex Grades)
5. Buried below structural slab: Stainless Steel

C. Cast-In- Place Inserts:

1. Cast-in-place inserts system shall be used.
2. Inserts to be UL and FM listed for their application.
3. Cast-In-Place Anchors shall be designed per ACI 318 Appendix D Strength Design methods as required by the IBC 2012 and ASCE 7-10. Where exempt from ACI 318 Appendix D, anchors may be designed using Allowable Stress Design loads with appropriate conversion factors where allowed by the Building Code.
4. Cast In Place inserts shall be tested in accordance with current ICC-ES acceptance criteria A.C. 446 or ACI 355.2 where required.
5. Cast In Place inserts in concrete shall have a current ICC-ES or IAPMO-UES listed Research Report. Anchors shall be installed and inspected in strict accordance with approved ICC-ES or IAPMO-UES Research Report for the specific anchor used.
6. Threaded Inserts shall conform to ASTM A307.
7. Size inserts to match size of threaded hanger rods.
8. Manufacturers:
 - a. DEWALT Bang-It+, Wood-Knocker II+, or DDI+
 - b. Hilti KCM-WF, KCC-WF, KCM-MD, or KCC-MD
 - c. Simpson Blue Banger Hanger

D. Channel Type Inserts:

1. Standard channel support with anchor tabs on 4" centers, and nail holes for attaching to forms.
2. Styrofoam inserts to prevent wet concrete seepage.
3. Minimum 2000 pounds/foot capacity.

E. Expansion, Screw, or Drop-In Anchors:

1. For use only where modifications to piping layouts to change from pre-installed insert locations and only under approval from the Engineer.
2. Inserts shall be wedge-type or screw type and shall be designed per ACI 318 Appendix D Strength Design methods as required by the IBC 2012 and ASCE 7-10. Anchors shall be tested in accordance with current ICC-ES acceptance criteria A.C. 193 or ACI 355.2. Anchors in concrete shall have a current ICC-ES or IAPMO-UES listed Research Report. Anchors shall be installed in strict accordance with the approved ICC-ES or IAPMO-UES Research Report for the specific anchor used.
3. Manufacturers:
 - a. DEWALT Power-Stud+ SD2 or Screw-Bolt+
 - b. Hilti Kwik-Bolt TZ2
 - c. Hilti KWIK HUS EZ
 - d. Hilti KWIK HUS EZ I

- e. Hilti HDI P TZ
 - f. Simpson Strong Bolt 2 or Titen HD Rod Hanger
- 4. Power driven fasteners are not acceptable.
 - 5. All Drop-in type anchors must be approved for cracked concrete.
 - 6. Anchors shall be installed with all required nuts, washers.
 - 7. Install anchors per Manufacturer's recommendations with proper torque values where required.
 - 8. Interior: Carbon steel anchors complying with ASTM A307.
 - 9. Exterior or Wet Environment: Series 300 stainless-steel anchors, nuts and washers.
 - 10. Anchors shall comply with loading requirements as designated by the Engineer of Record or per the Building Code.
- F. Steel Structure Attachments:
- 1. Contractor may select welded or mechanically attached. All mechanically attached supports shall have jam nuts or other means to prevent loosening. Maximum loading requirements are as follows:

Rod Size	Maximum Working Load
3/8	600 pounds
1/2	1100 pounds
5/8	1800 pounds
3/4	2700 pounds
7/8	3700 pounds
- G. Single Hangers:
- 1. Piping 2" and smaller: MSS type 1, Clevis hanger or type 7 adjustable swivel ring hanger. Minimum 180 pounds design load.
 - 2. Piping 2½" and larger: MSS type 1 Clevis hanger.
 - 3. Bare copper pipe: Above hangers, plastic or Neoprene coating, sized for copper pipe O.D. and copper coated for identification.
 - 4. Insulated pipe: Hangers to be sized for O.D. of insulation. Hangers shall not penetrate any insulation.
- H. Trapeze hangers and wall supports:
- 1. Channel strut or structural steel shapes. Contractor shall follow channel strut manufacturers guidelines for loading or provide structural steel supports designed by a professional Engineer, licensed in the same state as where the project is located.
 - 2. All piping shall be attached to the support by means of a channel strut clamp, U-bolt, or pipe rollers which will maintain lateral position of the pipe but allow longitudinal movement. Provide dielectric isolation between all dissimilar metals.
 - 3. All insulation shall be continuous at supports. Do not notch or penetrate insulation.
- I. Vertical Supports: Steel riser clamp at each floor penetration or every 14 foot supported from wall bracket. Do not anchor riser clamps.

J. Hangers:

1. General: Adjustable wrought steel clevis with locking nut attachment.
2. Multiple or Trapeze: Steel channels with welded spacers and hanger rods.
3. Hanger Sizes and Spacing:
 - a. For gas, domestic water and drain piping, conform to Chapter 2, Part 5, Section 121 of ASME B31.1 (Standard for Pressure and Power Piping) and applicable plumbing code.
 - b. For the piping systems listed below, conform to the following table:

PIPE TYPE	PIPE SIZE	MAXIMUM SPACING	MINIMUM HANGER ROD SIZE
Steel Pipe	1/2"	6'-0"	3/8"
	3/4" thru	8'-0"	3/8"
	1 1/4"	10'-0"	3/8"
	1 1/2" and 2"	12'-0"	1/2"
	2 1/2" thru	15'-0"	5/8"
	3 1/2"	17'-0"	3/4"
	* 4" and 5"	12'-0"	7/8"
	* 6"	10'-0"	1 1/4"
	* 8" thru 12"	8'-0"	1 1/2"
	14" thru 18"		
	20" thru 30"		
Copper Pipe	1/2" thru	6'-0"	3/8"
	1 1/4"	10'-0"	3/8"
	1 1/2" thru 2"	10'-0"	1/2"
	2 1/2" thru 3"		
Cast Iron Soil	2"	5'-0" **	3/8"
	3" to 5"	5'-0" **	1/2"
	6"	5'-0" **	5/8"
	* 8" to 12"	5'-0" **	3/4"
PVC	2"	4'-0" ***	3/8"
	3" to 5"	4'-0" ***	1/2"
	6"	4'-0" ***	5/8"
	* 8" to 12"	4'-0" ***	3/4"

* Submit routing and support plans to Architect/Engineer for review.

** The maximum horizontal spacing of cast-iron pipe hangers shall be increased to 10 feet where 10-foot lengths of pipe are installed.

*** Hanger spacing based on 2021 International Plumbing Code 308.5.

K. Insulated Pipe Supports:

1. Size pipe supports for outside diameter of pipe insulation.

- L. Wall Supports:
 - 1. 1/2" through 3": Unistrut type channel and steel clamp.
 - a. Use Hydra-Zorb cushions on copper pipe.
 - 2. 4" and Over: Welded steel bracket and wrought steel clamp.
- M. Pipes over five inches and over 120°: Provide cast iron roller supports.

2.2 PIPE POSITIONING SYSTEMS AT FIXTURE LOCATIONS

- A. Manufacturers:
 - 1. Design Basis: Holdrite
 - 2. Other Acceptable Manufacturers:
 - a. Sioux Chief
 - 3. In-wall plumbing systems serving fixtures and equipment shall be properly supported to prevent movement or vibration. The use of construction scrap materials for the purpose of supporting pipe and equipment is not allowed. All materials shall be new and manufactured for the purpose of supporting pipe and equipment.

2.3 INSULATION INSERTS

- A. All insulated pipes shall be protected at the point of support by insulation inserts. Insert to be same thickness as adjoining pipe insulation. Materials shall be suitable for use in an air plenum.
- B. Provide any of the following products:
 - 1. High density, 100 psi, waterproofed calcium silicate, encased in a sheet metal shield. Shield shall extend one inch beyond sheet metal shield. If pipe hanger spacing exceeds ten feet and for all pipe roller applications, utilize double layer shield on bearing surface.
 - 2. Trymer Polyisocyanurate Foam insulation (urethane). Provide compressive strength and temperature range as required for pipe served. Insert shall be provided with factory applied vapor barrier.
 - a. Manufacturers: Snapp Itz Mechanical Pipe Shields (BBMI, LLC) or pre-approved equal.
 - b. Not for use on steam piping or other piping above 225° F.
- C. Provide 180° insulation inserts when utilizing clevis hangers. Provide 360° insulation inserts at all trapeze and wall supports.

2.4 PIPE ANCHORS

- A. Manufacturers:
 - 1. Anvil

2. Cooper Industries B-Line
3. Mason
4. Metraflex

B. Design Basis – Any of the following:

1. Pipe Riser Anchor Clamp: Metraflex Riser Anchor Clamp
2. Low Load Anchor Clamp: Metraflex Model PA Anchor Clamp
3. Pre-insulated Anchor Clamp: Metraflex Model PAPI
4. Welded Structural W-Section Anchor: Metraflex Model PAI Structural I-beam Anchor

C. Material:

1. Material in contact with pipe shall be steel for steel pipe, bronze for copper tubing. Where clamp anchors are a dissimilar metal to piping, provide FRP pad secured to the pipe with epoxy adhesive to prevent metal to metal contact between clamp and pipe.

D. Anchors may be field fabricated similar to manufactured products specified.

E. Submit pipe stress analysis for review prior to installation of pipe anchors.

2.5 PIPE GUIDES

A. Manufacturers:

1. Adsko
2. Anvil
3. Cooper Industries B-Line
4. Flexicraft
5. Keflex
6. Mason
7. Metraflex
8. PHD

B. Design Basis – Any of the following:

1. Spider Type: Metraflex Style IV Spider Type guide
2. Roller Type: Two sets of rollers on opposite sides of pipe
3. Slide Type: Cooper Industries B-Line B3893 with hold down lugs (not for use with cold piping)
4. Light duty, 1-1/2" and smaller copper: U-bolt or channel strut clamp allowing clearance from O.D. of pipe or insulation
5. Pipe Riser Guides: Metraflex Modular Riser Guide

C. Material: Material in contact with pipe shall be steel for steel pipe, bronze for copper tubing. Where guides are a dissimilar metal to piping, provide FRP pad secured to the pipe with epoxy adhesive to prevent metal to metal contact between guide and pipe.

2.6 EXPANSION COMPENSATORS

A. Expansion Compensators, Two Inch and Smaller, Loop Type:

1. Manufacturers - Design Basis: Metraflex
2. Other Acceptable Manufacturers:
 - a. Adsko
 - b. Flexicraft
 - c. Keflex
 - d. Mason
3. Model: Metraloop

B. Expansion Compensators, Bellows Type:

1. Manufacturers – Design Basis: Metraflex
2. Other Acceptable Manufacturers:
 - a. Adsko
 - b. Flexicraft
 - c. Keflex
 - d. Mason
3. Model: MNLC, 300 psi max. working pressure

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPE SUPPORTS

- A. Adequately support piping from the building structure with adjustable hangers to maintain uniform grading where required and to prevent sagging and pocketing.
 1. Provide supports between piping and building structure where necessary to prevent swaying.
 2. Do not support pipe from other pipe or equipment.
 3. Provide thrust restraints at all changes in direction on 8" and larger cast iron piping with no hub or hub and spigot fittings.
- B. Install hangers to provide minimum 1/2" clear space between finished covering and adjacent work.
 1. Place a hanger within one foot of each horizontal elbow.
 2. Space hangers generally as called for in Table in Part 2, Products.
- C. Use hangers, which are vertically adjustable 1-1/2" minimum after piping is erected.

- D. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.
 - 1. Set inserts in position in advance of concrete work.
 - 2. Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
 - 3. Do not penetrate concrete “TT” legs for piping inserts. Do not penetrate the stressed (i.e. lower) chords of any structural member.
- E. Expansion anchors or screw anchors: For use only where modifications to piping layouts to change from pre-installed insert locations and only under approval from the Engineer.
 - 1. Installation shall be in strict compliance with ICC-ES or IAPMO-UES Research Report criteria.
 - 2. Expansion anchors require periodic special inspection as required by their ICC-ES or IAPMO-UES Research Report.
 - 3. Special inspector shall make periodic inspections of installation for compliance with manufacturer’s installation instructions.
- F. Provisions for Movement: Install hangers and supports:
 - 1. To allow controlled movement of piping systems.
 - 2. To permit proper movement between pipe anchors.
 - 3. To facilitate the action of expansion joints, expansion loops, bends and offsets.
 - 4. To isolate force due to weight or expansion from equipment connections.
- G. In general, attach hangers to upper chord of roof trusses and floor joists, using long rods to facilitate pipe movement.
- H. Anchors:
 - 1. Use no pipe anchors. Arrange piping such that pipe expansion and contraction is accommodated by controlled movement of the pipe within the pipe supports. Provide sufficient offsets in branch piping to accommodate movement of main piping due to expansion and contraction.

3.2 PIPE PROTECTION

- A. Provide shield plates to protect concealed piping in accordance with code. Protection shall be provided wherever piping is routed through a penetration or notch in building framing members with less than 1½-inch clearance. Shield shall extend not less than 2-inches on either side of interface and be constructed of 16-gauge steel.
 - 1. Protection is not required for cast-iron or steel piping.

END OF SECTION 23 05 29

SECTION 23 05 53 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUBMITTALS

- A. Submit manufacturer's product data on the following:
 - 1. Plastic Pipe Markers and method of application.
 - 2. Engraved Plastic Laminate Sign.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Except as otherwise indicated, provide manufacturer's standard products.
- B. Where more than a single type is specified for an application, selection is Installer's option, but provide a single selection for each application.

2.2 PLASTIC PIPE MARKERS (TYPE A)

- A. Provide manufacturer's standard pre-printed, flexible or semi-rigid, permanent, color-coded, plastic-sheet pipe markers, complying with ANSI A13.1.
- B. For Pipes Less Than Six Inches (including insulation if any): Provide full-band pipe markers, extending 360° around pipe at each location, fastened by one of the following methods:
 - 1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 - 2. Adhesive lap joint in pipe marker overlap.
 - 3. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".
- C. Lettering: Manufacturer's pre-printed wording which conforms to contract document system descriptions.
- D. Match existing terminology for systems which are modified by this work.
- E. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering or as a separate unit of plastic (to accommodate both directions).

2.3 STENCILING (TYPE B)

- A. Using a color contrasting to the surface to identify, spray or brush paint through neatly cut stencils.
- B. Lettering shall conform to wording on contract documents. Size shall be in accordance with ANSI A13.1.

2.4 BACKGROUND COLOR AND STENCILING (TYPE C)

- A. In addition to the requirements above, paint a background color band in accordance with ANSI A13.1.

2.5 VALVES TAGS

- A. Brass Valve Tags: Provide manufacturer's standard 19 ga brass tag; approximately 1-1/2" round with 1/2" high, black-filled numbers and 3/16" top hole.
 - 1. Numbers shall be sequential in accordance with schedule below.
 - 2. Provide separate numbering for each legend sequence. Provide separate sequences for the following:
 - a. Gas (GAS)
 - b. Plumbing (PLBG)
 - c. Heating Water (HTG)
 - d. All other systems (No legend)
- B. Valve Tag Fasteners: Manufacturer's standard chain (wire link or beaded type), or S-hooks.

2.6 VALVE SCHEDULE

- A. Provide schedule for each piping system, as defined on the drawings, and below, typewritten and reproduced on 8-1/2" x 11" bond paper.
- B. Tabulate valve number, piping system, system legend (as shown on tag), location of valve (room or space), and variations for identification (if any).
- C. Provide piping schematic for each system as defined below in Part 3.
- D. In addition to mounted copies, furnish extra copies for maintenance manuals as specified.
- E. Valve Schedule Frames: For each page of the valve schedule, provide a glazed frame, with screws for removable mounting on masonry walls.

2.7 ENGRAVED PLASTIC-LAMINATE SIGNS

- A. General: Provide engraving stock melamine plastic laminate, 1/16" thick, black with white core (letter color).

B. Fastening:

1. Screws
2. Rivets
3. Permanent Adhesive

C. Lettering and Graphics:

1. Coordinate names, abbreviations and other designations used in the mechanical identification work, with the corresponding designations shown, specified or scheduled in the construction documents.
2. In addition, for heating or cooling units and exhaust fans, identify area served.

PART 3 - EXECUTION

3.1 GENERAL

- A. Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, install identification after completion of covering and painting.
- B. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 DUCTWORK IDENTIFICATION

- A. **General:** Identify air supply, return, exhaust, intake and relief ductwork with stenciled signs and arrows, showing ductwork service and direction of flow, in black or white, whichever provides most contrast with ductwork color.
- B. **Location:** In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50' spacing along exposed runs.
- C. **Access Doors:** Provide stenciled or plastic laminate type signs on each duct or equipment-mounted access door in ductwork and housings, indicating the purpose of the access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.

3.3 PIPING SYSTEM IDENTIFICATION

- A. General: Install pipe markers on piping of the following systems and include arrows to show normal direction of flow.
 1. Domestic water piping (hot, cold, tempered; 120° hot, 180° hot, hot water recirculating, etc.).
 2. Plumbing vent and sanitary (above grade) piping.

3. Storm piping.
 4. Fire protection.
 5. Any other piping system as indicated on the drawings, or as required to match existing.
- B. Locate pipe markers and color bands, as follows, on all piping exposed to view, above an accessible ceiling, and in accessible maintenance spaces (including chases and near access panels). In spaces exposed to view in public areas, effort is to be made to coordinate exact locations with architect.
1. Near each valve and control device.
 2. Near each branch, excluding short take-offs for fixtures and terminal units. Mark each pipe at branch, where there could be a question of flow pattern.
 3. Near locations where pipes pass through walls, floors, or ceilings, or enter non-accessible enclosures.
 4. Near major equipment items and other points of origination and termination.
 5. Spaced intermediately at maximum spacing of 50' along each piping run.
 6. Within 6' of access doors above otherwise non-accessible ceilings and chases.
- C. Type:
1. Normally exposed to view - Type A or C.
 2. Normally concealed from view - Type B.

3.4 VALVE IDENTIFICATION

- A. Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory fabricated equipment units, plumbing fixtures faucets, hose bibs, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.
- B. Mount framed valve schedules with piping schematics where directed by Architect.
- C. Identify each valve tagged on as-built drawings.

3.5 NON-POTABLE WATER IDENTIFICATION

- A. Provide an engraved plastic laminate sign.
1. Legend: "Non-Potable Water".
 2. Location: At each outlet of piping downstream of backflow preventer, (e.g. Boiler Room hose bibb).

END OF SECTION 23 05 53

SECTION 23 05 93 - TEST-ADJUST-BALANCE

PART 1 - GENERAL

1.1 RESPONSIBILITY

- A. The Balancing Contractor shall be a sub-contractor, directly working for the General Contractor.
- B. The Balancing Contractor shall not be a sub-contractor of any other Division 21, 22 or 23 Contractor.

1.2 QUALITY ASSURANCE

- A. Qualification:
 - 1. Work shall be done by a firm certified by the National Environmental Balancing Bureau (NEBB), or the Associated Air Balance Council (AABC), or the firm shall have technicians certified by the "National Training Fund Sheet Metal & Air Conditioning Industry".
 - 2. The firm shall be an independent testing and balancing firm specializing in testing and balancing of environmental systems.
 - 3. The firm shall have an experience record of not less than five (5) years of experience in the TAB industry.
- B. Industry Standards: Comply with the following:
 - 1. HVAC Systems-Testing, Adjusting, Balancing published by Sheetmetal and Air Conditioning Contractors National Association, Inc. (SMACNA).
 - 2. Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems published by National Environmental Balancing Bureau. (NEBB).
 - 3. ASHRAE Systems Handbook. Testing, Adjusting and Balancing.
- C. Registration: Work shall be done under the supervision of a professional engineer registered in Colorado. Engineer shall be available for all meetings and interpretation of all materials in the report.
- D. Pre-qualification of TAB Contractor.
 - 1. The firm must have experience and qualifications satisfactory to the consulting mechanical engineer and must be accepted by them prior to bidding.
 - 2. Firms desiring approval to provide work under this section shall submit a booklet indicating procedures and data forms that they would use in the performance of the work.
 - 3. Submittals shall be in accordance with Division 1.
 - 4. Only firms which have been approved by the mechanical engineer prior to bid date may provide work under this section.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 GENERAL

- A. Sequence work to commence after completion of system and start-up procedures and schedule completion of work before Substantial Completion of Project.
- B. Examine the installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned and is operable.
- C. Notify the Contractor in writing of conditions detrimental to the proper completion of the test-adjust-balance work.
 - 1. Do not proceed with the work until unsatisfactory conditions have been corrected.
 - 2. Provide Engineer/Architect with a copy of the notification.
- D. Adjust air flows and heating water systems to within 10% of values shown. Adjust chilled water systems to within 5% of values shown. If design flows cannot be obtained within specified limits the Balancing Contractor will perform the following (at the minimum):
 - 1. Measure and record major pressure drops in the system.
 - 2. Consult with the Engineer and Installer as required.
 - 3. Upon receiving written directions to proceed and after any corrections are performed, re-balance affected portion of system.
- E. Optimization: Work closely with the Section 23 09 00 contractor to optimize setpoints.
 - 1. Establish the minimum air static pressure or water differential pressure for variable or bypass flow system.
 - 2. Establish the position of minimum outside air dampers, damper/valve and sequencing relays.
- F. Calibration: Be responsible for calibration of flow measurement devices used as input to the temperature control system. All air systems flow measurement stations including VAV terminals shall be calibrated against a pitot tube traverse or air diffuser capture hood. Balancing contractor shall assure accuracy of all flow measurement devices or shall report on their failure to be accurate.
- G. Patch holes in insulation, ductwork and housings, which have been cut or drilled for test purposes, in a manner recommended by the original Installer.
- H. Make all final readings for each system at the same time, and after all adjustments have been made.

- I. Mark equipment settings, including damper control positions, balancing cocks, circuit setters, valve indicators, fan speed control settings and similar controls and devices, to show final settings at completion of test-adjust-balance work.
 - 1. Mark with paint or other suitable permanent identification material.
- J. Check all new thermal overloads.
 - 1. Identify improperly protected equipment in report.

3.2 EXISTING AIR SYSTEMS

- A. Scope: Existing air systems within scope are to be pre-balanced. Existing air systems within scope to be balanced utilizing pre-balance report and airflow values noted on mechanical plans.
- B. Before any testing is done, make note of any of the following existing conditions found:
 - 1. Dirty air intakes
 - 2. Duct leakage
 - 3. Damper leakage, or blockage
 - 4. Equipment vibrations
 - 5. Correct damper operation
- C. Pre-balance procedure:
 - 1. Measure and report the following for all exhaust air systems within scope:
 - a. Individual air inlet and outlet airflows.
 - b. Plot operating point on fan curve. Include compensation for effects of altitude and inlet vanes.
- D. Maintain pre-balance report through construction.
- E. New work procedure:
 - 1. Measure and report the following for all exhaust air systems within scope:
 - a. Individual air inlet and outlet airflows.
 - b. Plot operating point on fan curve. Include compensation for effects of altitude and inlet vanes.
 - 2. Balance existing exhaust air outlets based on pre-balance report.
- F. Exchange sheaves and belts as required to adjust the rpm of all fans so they handle specified air quantity.

3.3 EXISTING DOMESTIC HOT WATER RECIRCULATION SYSTEM

- A. Scope: Perform pre-construction balance of existing hot water re-circulation systems.

- B. Before any testing is done, make note of any of the following existing conditions found:
 - 1. Check temperature control device operation (mixing valves, external temperature control devices, etc.).
 - 2. Check rotation of pumps.
 - 3. Verify proper operation of ASME pressure and temperature relief valves.
- C. Using flow meters, adjust the quantity of water circulated by existing pump and the flow in each branch of the hot water re-circulation systems as shown on plumbing plans and from pre-construction balance report.

3.4 EXISTING HYDRONIC SYSTEMS

- A. Scope: Balance all existing hydronic systems within scope.
- B. Before any adjustments are made:
 - 1. Check temperature control valve operation.
 - 2. Check pump rotation.
 - 3. Adjust pressure reducing valve.
 - 4. Remove any roughing strainer screens in systems.
- C. Using system flow meters, adjust the quantity of fluid handled by each pump and supplied to each coil within scope shown on plans to meet design requirements.
- D. Procedure:
 - 1. Measure and report all hydronic systems by all of the below means which are applicable.
 - a. Terminal flow measuring stations.
 - b. Terminal pressure drop, compare to submittal data.
 - c. Plot operating point on pump curve. Include compensation for effects of temperature, viscosity and density.
 - 2. Above measurements to be made and reported at full heating/cooling load.
 - a. For 3-way valve terminals/heat exchangers set bypass flow to equal coil flow.
 - b. For primary/secondary systems, set crossover/bride to have constant flow at all conditions.

3.5 DETAILED REQUIREMENTS

- A. Measure, adjust and report the following:
 - 1. Ductwork Systems:
 - a. Airflow at each inlet and outlet.
 - b. Airflow at supply, return, outside air, and exhaust mains to determine total airflow.
 - c. VAV box entering and leaving air temperature.
 - d. VAV box entering and leaving static pressure.

- e. VAV box airflow at minimum position, maximum position, and heating position.
 - f. Space temperature at thermostats or sensors.
- 2. Environmental Fans:
 - a. Total fan CFM.
 - b. Fan speed.
 - c. Fan total static pressure.
- 3. Coils:
 - a. Coil airflow.
 - b. Coil entering and leaving air temperature.
 - c. Coil entering and leaving air pressure.
 - d. Coil water flow.
 - e. Coil entering and leaving water temperature.
 - f. Coil entering and leaving water pressure.

3.6 REPORT

- A. Provide a general information sheet listing:
 - 1. Instruments used:
 - a. Most recent calibration date.
 - 2. Method of balancing.
 - 3. Altitude correction.
 - 4. Manufacturer's performance data for all air devices used.
- B. Provide data sheets for all equipment, including motors and drives, listing:
 - 1. Make
 - 2. Size
 - 3. Serial number
 - 4. Capacity Rating
 - 5. Amperage
 - 6. Voltage input
 - 7. Thermal heater size for each motor
 - 8. Operating speed of driver and driven devices
 - 9. Any additional pertinent performance data
- C. Include design and final values for all items listed in Detailed Requirements, and totals for each system.
- D. Provide data sheets showing:
 - 1. Air flow at each inlet and outlet
 - 2. Instrument used
 - 3. Velocity reading
 - 4. Manufacturer's free area factors

- E. Provide recap sheet with explanation for each device not meeting specified performance.
- F. Provide a set of prints with equipment, inlets and outlets marked to correspond to data sheets.

3.7 VERIFICATION

- A. Upon completion of the TAB work the balancing firm shall demonstrate fluid flow quantities indicated in a preliminary TAB report.
 - 1. The TAB representative shall be a member of the same team used during the original testing.
 - 2. Equipment used during the random testing shall be the same equipment used during the original testing.
 - 3. The system or equipment being verified shall be in the same operating mode as during the original TAB test.
 - 4. Up to 10% of the air readings shall be re-tested. Ninety percent (90%) of the re-tested readings must be within tolerances of the specifications.
 - 5. Up to 10% of the balanced heating hydronic component readings shall be re-tested. Ninety percent (90%) of the re-tested readings must be within tolerances of the specifications.
 - 6. Up to 20% of the balanced chilled water component readings shall be re-tested. Ninety percent (90%) of the re-tested readings must be within tolerances of the specifications.
 - 7. Whenever system verifications do not meet these specifications, the entire system shall be re-balanced and rechecked.

3.8 COMMISSIONING

- A. Reference Section 23 08 00 for commissioning scope.
- B. Provide all necessary personnel, tools and equipment to comply with the commissioning scope.

END OF SECTION 23 05 93

SECTION 23 07 00 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 SUBMITTALS

- A. Submit manufacturer's product data on the following:
 - 1. Insulation.
 - 2. Jackets, coatings and protective finishes.
 - 3. Sealers, mastics and adhesives.
 - 4. Fitting covers.
 - 5. Manufacturer's installation details for fire rated duct wrap.
 - 6. Low-Emitting Adhesives and Sealants EQc4.1 requirements for LEED submittals.

1.2 FLAME AND SMOKE RATINGS

- A. Provide insulation tested on a composite basis (insulation, jacket, covering, sealer, mastic and adhesive) complying with the following:
 - 1. Flame Spread: 25 or Less
 - 2. Smoke Developed: 50 or Less
 - 3. Method: ASTM E84 (NFPA 255)

1.3 PRODUCT DELIVERY

- A. Deliver insulation products in factory containers bearing manufacturer's label showing fire hazard rating, density and thickness.

1.4 DEFINITIONS

- A. Exposed Location: Located in mechanical rooms or other areas exposed to view.
- B. Concealed Location: Located in pipe chases, furred spaces, attics, crawl-spaces, above suspended ceilings, or other locations not exposed to view.

1.5 STANDARDS

- A. Comply with the latest edition of National Commercial and Industrial Insulation Standards.

PART 2 - PRODUCTS

2.1 PIPE INSULATION

A. Manufacturers:

1. 3M
2. Aeroflex
3. Alkegen/Unifrax
4. Armacell
5. ITW
6. Johns-Manville
7. K-Flex
8. Knauf
9. Manson Insulation
10. Owens-Corning

B. Materials:

1. **Type FP** - Fiberglass Pipe Insulation: Johns-Manville Micro-Lok heavy density pipe insulation with AP-T jacket.
2. **Type FPF** - Fiberglass Pipe Fitting Insulation: Johns-Manville "Zeston" fitting covers with factory-cut fiberglass insulation insert.
3. **Type FCCP** - Flexible Closed Cell Pipe Insulation: Armacell AP Armaflex, Aeroflex Aerocel, or K-Flex Insul-Tube. Compliant with ASTM E 84, NFPA 90A, and NFPA 90B.
4. **Type FCCP-O** – UV Resistant Flexible Closed Cell Pipe Insulation: Armacell UT Solaflex, Aerocel AC, K-Flex Insul-Tube with AL Clad System.
5. **Type CGP** - Cellular glass with vapor barrier coating: Owens Corning FOAMGLAS.
6. **Type RCCP** - Rigid Closed Cell Insulation (not for use indoors): ITW Trymer 2000XP, Dyplast ISO-C1/2.0, or GLT Products ISO-C1.
7. **Type PFW** - Plenum Fire Wrap: 3M Fire Barrier Plenum Wrap 5A+ or Alkegen/Unifrax FyreWrap 0.5 Plenum Insulation.

Materials indicated are provided as design basis. Equivalent insulation product by manufacturer indicated above is acceptable.

C. Insulation thickness and conductivity: (Thickness and conductivity listed below are minimum required. Provide thickness and conductivity required by Local Building or Energy Codes).

1. Service (Domestic) Water Piping:
 - a. Hot, 140°F and under: (Insulation conductivity: 0.21–0.28 (Btu x in.)/(h x ft² x °F))
 - 1) Sizes smaller than 1-½": 1"
 - 2) Sizes 1-½" and larger: 1-½"
 - b. Cold, 40°F to 60°F: (Insulation conductivity: 0.21–0.27 (Btu x in.)/(h x ft² x °F))
 - 1) Sizes smaller than 1-½": ½"
 - 2) Sizes 1-½" and larger: 1"
2. Primary and Overflow Storm Water:
 - a. All Sizes: 1"

3. Repairs to Existing Insulation: Match thickness of existing insulation.
4. All other piping not listed above:

FLUID TEMPERATURE RANGE (°F)	CONDUCTIVITY RANGE (in Btu-inch per hour per square foot per °F)	INSULATION MEAN RATING TEMPERATURE (°F)	NOMINAL PIPE DIAMETER (in inches)						
			< 1	1 to <1.5	1.5 to < 4	4 to < 8	8 and larger		
			INSULATION THICKNESS REQUIRED (in inches)						
Space heating, Hot Water systems (steam, steam condensate and hot water) and Service Water Heating Systems (recirculating sections, all piping in electric trace tape systems, and the first 8 feet of piping from the storage tank for nonrecirculating systems)									
Above 350	0.32-0.34	250	4.5	5.0	5.0	5.0	5.0		
251-350	0.29-0.32	200	3.0	4.0	4.5	4.5	4.5		
201-250	0.27-0.30	150	2.5	2.5	2.5	3.0	3.0		
141-200	0.25-0.29	125	1.5	1.5	2.0	2.0	2.0		
105-140	0.22-0.28	100	1.0	1.5	1.5	1.5	1.5		
Space cooling systems (chilled water, refrigerant and brine)									
40-60	0.21-0.27	75	Nonres 0.5	Res 0.75	Nonres 0.5	Res 0.75	1.0	1.0	1.0
Below 40	0.20-0.26	50	1.0	1.5	1.5	1.5	1.5	1.5	

D. Application: Unless otherwise indicated, use the following:

1. Inside, above ground: **Type FP** fiberglass.
2. Inside exposed: **Type FP** fiberglass with PVC jacket (jacket not required in mechanical rooms).

2.2 DUCT INSULATION

A. Manufacturers:

1. Aeroflex
2. Armacell
3. Certainteed
4. Johns Manville
5. K-Flex
6. Knauf
7. Owens-Corning

B. Materials:

1. **Type FDL** – Fiberglass Duct Liner: See Section 23 31 13, for duct liner requirements.
2. **Type FCCL** – Flexible Closed Cell Duct Liner: See Section 23 31 13, for duct liner requirements.
3. **Type FDW** - Flexible Faced Fiberglass Ductwork Insulation Wrap: Johns-Manville Microlite, with FSK factory applied foil-scrim-kraft facing. ASTM E 84 compliant.
4. **Type RDB** - Rigid Fiberglass Ductwork Insulation: Johns-Manville 800 Series, Spin-Glas Type 814, 3 lb. Density rigid board with FSK jacket.
5. **Type RDB-O** - Rigid Glass Mineral Wool Ductwork Insulation: Knauf Earthwool with all service jacket (ASJ).

6. **Type FD** - Flexible Plain Fiberglass Ductwork Insulation: Johns-Manville Microlite .75 lb/cu. Ft. unfaced.
7. **Type FCCD** - Flexible Closed Cell Duct Insulation: Armacell AP Armaflex, Aeroflex Aerocel, or K-Flex Insul-Sheet. ASTM E 84 compliant. Where located outside the building envelope, provide UV resistant paint.
8. **Type CGD** - Cellular Glass Ductwork Insulation: Owens Corning FOAMGLAS with vapor barrier.
9. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles, and similar accessories as recommended by the insulation manufacturer for the applications indicated.

Materials indicated are provided as design basis. Equivalent insulation or jacketing product by manufacturer indicated above is acceptable.

C. Application:

SYSTEM	EXPOSED	CONCEALED
Supply	1 ½" Type FDL duct liner	1 ½" Type FDL duct liner
Return	1 ½" Type FDL duct liner	1 ½" Type FDL duct liner
Exhaust	None	None

1. Reference 23 07 00/ Duct Insulation and 23 31 13/ Duct Liner.
2. Where energy codes require additional insulation over that listed above, provide insulation in accordance with those codes.
3. Insulate all accessories and components (fire dampers, silencers, air valves, etc.) of the duct systems noted above as requiring insulation. Where lined systems contain components that cannot be lined or have not been provided with liner, insulate them. That insulation shall overlap the lined portion of the system by at least 12 inches.
4. Build up and pitch insulation to prevent water ponding on rectangular ductwork 36" or greater in width.
5. Round ducts concealed above ceilings and serving individual terminal units or diffusers may be wrapped in lieu of liner.

PART 3 - EXECUTION

3.1 GENERAL

- A. Verify acceptability of all materials which are to be used in air plenums (above ceiling, etc.). Materials must meet all requirements of Local Building Code and Authority having jurisdiction.

3.2 PIPE INSULATION

- A. Insulate the following:
 1. Domestic hot water piping.
 2. Domestic cold water piping above ground and under slab.
 3. All horizontal primary and overflow storm water piping.

4. All existing piping which is currently insulated and which is modified as a result of this work.
5. Storm and sanitary piping where subject to freezing conditions.

B. Installation:

1. Install insulation on pipe system subsequent to testing and acceptance of tests.
2. Install insulation materials with smooth and even surfaces.
 - a. Insulate each continuous run of piping with full length units of insulation, with a single cut piece to complete the run.
 - b. Do not use cut pieces or scraps abutting each other.
3. Clean and dry pipe surfaces prior to insulating.
 - a. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.
4. Extend piping insulation without interruption through pipe clamps, hangers, walls, floors and similar piping penetrations, except where otherwise indicated. **Hangers and supports must be installed outside, not through, insulation.**
5. Install protective metal shields and saddles where needed to prevent compression of insulation. Refer to Section 23 05 29.
6. Except as noted, cover valves, flanges, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run.
 - a. Install factory-molded, pre-cut or job-fabricated units (at Installer's option), except where a specific form or type is indicated.
 - b. Do not cover:
 - 1) Valve operators.
 - c. Provide removable access for:
 - 1) Strainers.
 - 2) Other components requiring access for service.
7. Mark location of unions and flanges covered by insulation with permanent paint or ink, or approved label.
8. Maintain integrity of vapor-barrier jackets on insulation of cold pipes and storm drainage piping, and protect to prevent puncture or other damage.
9. Insulate between pipe and pipe saddles. Provide suitable saddles.
10. Seal ends of sections with vapor barrier cement to create moisture dams at:
 - a. 21 ft. intervals.
 - b. Valves and fittings.
 - c. All hangers and supports.
11. Replace existing insulation removed or damaged because of work of this project.
12. Insulate new pipes and replace insulation on existing pipes to remain where insulation was removed or damaged by demolition or revisions.
13. Do not insulate basket access flange of flanged strainers.
14. Do not insulate steam traps.
15. Insulate between fingers of spiders in alignment guides.
16. Insulate between pipe and pipe slide.
17. Perform all work in a neat and workmanlike manner. Poor work (as determined by Architect or Engineer) will be cause for rejection.

3.3 DUCTWORK INSULATION

- A. Install insulation materials with smooth and even surfaces.
- B. Clean and dry ductwork prior to insulating.
 - 1. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- C. Extend ductwork insulation without interruption through walls, floors, and similar ductwork penetrations, except where otherwise indicated. **Hangers and supports must be installed outside, not through, insulation.**
- D. Except as otherwise indicated, do not insulate lined ducts. However, extend duct insulation 12" beyond start of lining where lined ductwork meets insulated ductwork.
- E. Maintain integrity of vapor-barrier on insulation of ducts carrying cold air, and protect it to prevent puncture and other damage.

3.4 EQUIPMENT INSULATION

- A. VAV Terminals:
 - 1. Replace existing insulation at heating water coil ends that has been removed or damaged because of work of this project.

3.5 PROTECTION AND REPLACEMENT

- A. Replace damaged insulation which cannot be repaired satisfactorily. Including units with vapor barrier damage and moisture saturation.
- B. Protection: The insulation installer shall advise the Contractor of required protection for the insulation work during the remainder of the construction period, to avoid damage and deterioration.

3.6 ASBESTOS REMOVAL

- A. It is understood and agreed that this work does not contemplate handling of, or design including use of, asbestos or any hazardous waste material. Therefore, Owner and Contractor agree to hold harmless, defend and indemnify consultant (A/E) for all claims, lawsuits, expenses or damages arising from or related to the handling, use, treatment, purchase, sale, storage or disposal of asbestos, asbestos products or any hazardous waste materials.
- B. In the event asbestos is encountered the Contractor shall immediately cease work in the area of the asbestos shall contact the Engineer and Owner for instructions.

C. Regulations:

1. Follow Section 1910.1001 Code of Federal Regulations Title 29, Part 1910 (OSHA Asbestos Regulations).
2. Provide daily sampling during removal instead of at six month intervals.
3. Stop work and notify Architect immediately if levels exceed those of Subparagraphs b (2) or b (3) of regulations.
4. Dispose of material containing asbestos using methods approved by EPA at sites approved by EPA.

END OF SECTION 23 07 00

SECTION 23 08 00 - BUILDING MECHANICAL SYSTEM COMMISSIONING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The requirements of the General Conditions, Supplemental Conditions and Section 23 05 02 apply to all work specified in this section.
- B. Refer to Specification Section 23 05 93, title "Test and Balance" for interface requirements with test and balance contractor.

1.2 DESCRIPTION OF WORK

- A. This specification covers the start-up, operating performance test and commissioning of the HVAC systems. The purpose of this effort is to bring the project mechanical systems to a state of dynamic operation in accordance with the contract documents by verifying the operation of individual components, subsystems and systems.
- B. The Owner will retain the services of an independent commissioning agent (CxA) separate from the work of this Contract. As herein specified the Owner and CxA shall develop detailed commissioning procedures, equipment checkout procedures and data forms for recording compliance with contract documents, performance and punchlist deficiencies, and will assist in developing schedules for checkout and Owner acceptance, at a future date during the construction phase.
- C. The Division 23 Mechanical Contractor and the General Contractor shall include as part of the work of this contract, labor and material to provide manpower, equipment, tools, ladders, instruments, etc. necessary to accomplish the work and labor and material for execution, monitoring and printing data forms necessary to verify and record system observations.
- D. The Test and Balance Contractors shall include as part of the work of this contract, labor and material to provide manpower, equipment, tools, ladders, instruments, etc. necessary to execute and accomplish the work.
- E. At the completion of the start-up, operations performance test and test and balance, the Contractor shall conduct a 72 hour dynamic mode demonstration of the systems in the presence of the Owner/Architect/Engineer and CxA.

1.3 COMMISSIONED EQUIPMENT

- A. All VAV boxes as scheduled.
- B. All fans affected by scope of work.

1.4 COMMISSIONED SYSTEMS

- A. All HVAC and Service Water Heating systems, as required by the 2021 International Energy Conservation Code.

PART 2 - PRODUCTS

2.1 MATERIALS, LABOR, INSTRUMENTS, TOOLS, LADDERS AND APPARATUS

- A. The Contractor shall provide all materials, labor, instruments, tools, ladders and apparatus necessary to start-up, perform operating performance test and systems conditioning.
- B. The Contractor shall be responsible for maintaining the commissioning documentation until final acceptance of the project. Final checklists will be produced by the CxA and provided prior to beginning commissioning. The commissioning documentation shall be kept current by the Contractor and shall be available for inspection at all times. At the time of acceptance of the project, the Contractor shall surrender 3 completed copies of the commissioning documentation to the Owner's representative.

PART 3 - EXECUTION

3.1 START-UP AND OPERATING PERFORMANCE TEST

- A. Before request for contract compliance inspection and system commissioning all equipment, components, and systems shall be started-up, adjusted, calibrated; set, test and check all electric disconnect, fuses, circuit breakers, valves, dampers, temperatures and pressures of all systems for proper operation and performance. After completion of the start-up and operating performance test, the Contractor will notify the Owner in writing that the system is ready for commissioning.
- B. Information, date, etc. from start-up and operating performance test may be utilized, as appropriate, to execute preliminary commissioning documentation, however, certification of equipment and systems for the preliminary commissioning phase shall be completed in accordance with paragraph 3.2 of this section of the specifications.
- C. Start-up and operating performance test documentation shall include the following:
 - 1. Ductwork Systems:
 - a. Airflow at each inlet and outlet.
 - b. Airflow at supply, return, outside air, and exhaust mains to determine total airflow.
 - c. VAV box entering and leaving air temperature.
 - d. VAV box entering and leaving static pressure.
 - e. VAV box airflow at minimum position, maximum position, and heating position.
 - f. Space temperature at thermostats or sensors.

2. Environmental Fans:
 - a. Total fan CFM.
 - b. Fan speed.
 - c. Fan total static pressure.
3. Coils:
 - a. Coil airflow.
 - b. Coil entering and leaving air temperature.
 - c. Coil entering and leaving air pressure.
 - d. Coil water flow.
 - e. Coil entering and leaving water temperature.
 - f. Coil entering and leaving water pressure.

3.2 SYSTEM COMMISSIONING

- A. All systems, components, equipment, etc. furnished as part of this Contract shall be subjected to system commissioning as hereinafter specified. All systems, components, equipment, etc. commissioned in this section of the Specifications shall be evaluated based on the sequences of control/operation, performance characteristics, and equipment schedules, etc. as specified in other sections of the Specifications and as shown on the contract drawings. Systems, components, equipment, etc. that does not have specified operating sequence, etc. shall be operated and evaluated based on its use and function for this project.
- B. Commissioning Documentation: The Contractor shall maintain the commissioning documentation in 3-ring binders. The commissioning documentation shall be organized by system when practicable. All pages shall be numbered and a table of contents page shall be provided. The commissioning documentation shall include, but not be limited to, the following:
 1. Design Criteria provided by the A/E.
 2. Approved Test and Balance Report for the system or component being commissioned, provided by Test and Balance Contractor.
 3. Approved submittals for all equipment to be commissioned, provided by Mechanical Contractor.
 4. All approved shop drawings of equipment to be commissioned. Shop drawings shall be full size sheets folded as required to fit in binders. Provided by Mechanical Contractor.
 5. All pre-commissioning checklists initialized by indicated personnel organized by system and subsystem.
 6. All functional performance test checklist initialized by indicated personnel organized by systems and subsystems.
 7. Three copies of the Operation and Maintenance Manuals specified in other sections of these specifications shall be reviewed by the CxA for completeness and for applicability. The manuals shall be incorporated in the Commissioning Documentation prior to the commencement of the training required in other sections of the specifications. Preparation of Operation and Maintenance Manuals shall be as specified in other sections of these specifications.
- C. Shop Drawings and As-Built Drawings and Specifications shall be assembled by the Contractor after completion of the pre-commissioning phase and turned over to the Owner's representative.

Changes as a result of subsequent Commissioning procedures will be incorporated (as required) at the conclusion of final Commissioning.

D. Commissioning Schedule:

1. Phase 1 - Preliminary Commissioning: All shop drawings, including but not limited to, equipment, controls, test and balance reports, and operation and maintenance manuals, shall be submitted and approved by the CxA. In addition, all pre-commissioning checklists shall be completed (initialed by all parties).
2. Phase 2 - Functional Performance Testing shall be performed as indicated on the Functional Performance Test Checklists. Functional Performance Testing shall not begin until Phase 1 of the commissioning process is complete. Owner's operation and maintenance personnel shall observe the function performance testing. The Contractor may perform initial system familiarization and training of Owner's operating and maintenance personnel required under other sections of the Specification during the functional performance testing.
3. Functional Performance Test Notification: The Contractor shall notify the CxA 2 weeks before functional performance testing is to begin.

E. Pre-Commissioning Checklists:

1. Pre-Commissioning Checklists shall be developed by the CxA and shall be executed and certified prior to the commencement of functional performance testing. The indicated initial is required in each location for all items, except where an "X" is shown indicating an initial is not required. See initials legend below for required initials. The pre-commissioning checklist will not be accepted as complete until all items have been initialed signifying this portion of the project is ready for Functional Performance Testing. The Contractor shall provide the CxA with the completed Pre-Commissioning Checklists for their review and initials. The CxA shall be the last person to initial each checklist item. The Contractor shall submit for approval a list of all contractor and subcontractor representatives responsible for the completion of the pre-commissioning checklist phase of the project. This list of representatives shall be submitted 2 weeks prior to commencement of any pre-commissioning activities of any systems or equipment. Representatives may be replaced only after written approval from the CxA.
2. Initials Legend:
 - a. Construction Manager.
 - b. Mechanical Contractor's representative.
 - c. Electrical Contractor's representative.
 - d. Commissioning Agent.
 - e. Balancing Contractor's representative.
 - f. Controls Contractor's representative.
3. A separate Pre-Commissioning checklist shall be provided for each system and piece of HVAC equipment to be Commissioned.

F. Functional Performance Test Checklist:

1. Functional performance testing shall be performed by the Contractor as directed by the CA and observed by a commissioning team consisting of the individuals indicated on the Functional Performance Test Checklists. The Contractor shall submit in writing a list of

all contractor and subcontractor representatives responsible for the functional performance testing phase of the project. This list of representatives shall be submitted 2 weeks prior to the commencement of functional performance testing of systems and equipment. All representatives shall remain on the commissioning team throughout functional performance testing. Substitutions will not be permitted. Functional performance test checklists shall be completed in the presence of all commissioning team personnel at the time of the functional performance test.

2. Upon failure of completion of a functional performance test checklist, the Contractor shall provide a written report to the CxA listing the deficiencies causing the failure and remedies to correct all deficiencies. After the Contractor has corrected all deficiencies, the entire functional performance test checklist for the item of equipment shall be repeated. If possible, corrections can be accomplished during the functional performance testing of equipment in other non-related systems. In any case, no system will be accepted until all equipment items in the system have complete functional performance test checklists thereby demonstrating satisfactory performance.
3. Failure to complete 2 functional performance test checklists constitutes failure of Phase 2 of the HVAC Commissioning process. The Contractor shall provide a written report to the CxA listing the deficiencies causing all failures and remedies to correct all deficiencies. After correction of all deficiencies, Phase 2 of the HVAC Commissioning process shall be repeated in its entirety. The Contractor shall give the CxA 2 weeks notice before repeat functional performance testing is scheduled. Should the first or one subsequent functional performance test fail, the Owner reserves the right to obtain compensation from the Contractor for fees and expenses incurred in conjunction with having to perform more than two (2) functional performance tests.

END OF SECTION 23 08 00

SECTION 23 08 01 - COMMISSIONING AGENT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to section 23 08 00 for commissioning requirements and Division 1 for additional information.

1.2 DESCRIPTION OF THE WORK

- A. This Section covers the Scope of Work for the Commissioning Agent (CxA) who will be hired by the Owner.
- B. The Commissioning Agent shall oversee the commissioning of the HVAC systems as described in Section 23 08 00. The CxA shall prepare precommissioning and functional performance test checklists to be used by the Contractor. Prepare and publish a commissioning plan. Witness startup and operational tests of equipment and systems. Perform observations of the mechanical systems throughout construction and prepare the final commissioning document.
- C. The CxA shall have authority to direct and schedule test. The CxA shall have no authority to direct changes to the systems, or provide design related review comments.

1.3 COMMISSIONING PLAN

- A. The CxA shall prepare a plan listing the parties involved with their responsibility, scope, definitions, safety concerns, design criteria, attendance schedules, commissioning schedules, and commissioning manual requirements.

1.4 COMMISSIONING FORMS

- A. Review 100% CD's. Provide written summary of how each commissioned item of equipment, should operate include calculations verifying scheduled capacity.
- B. The CxA shall develop forms similar to that in Section 23 08 00 for the Contractors use during the commissioning process. The forms shall become part of the final commissioning manual. Forms shall be provided for each piece of commissioned equipment and system. Any deviations from the design shall be noted and proved by the Owner prior to acceptance. Each form shall be signed by the Contractor, CxA and Owner prior to acceptance of a system or piece of equipment.

1.5 COMMISSIONED EQUIPMENT

- A. All VAV boxes as scheduled.
- B. All fans affected by scope of work.

1.6 COMMISSIONED SYSTEMS

- A. All HVAC and Service Water Heating systems, as required by the 2021 International Energy Efficiency Code.

1.7 PROJECT OBSERVATIONS

- A. The CxA shall perform observations of the commissioned equipment and systems twice a month at a minimum and more as required to keep pace with construction. The CxA shall note progress and any deviations of the construction documents shall be brought to attention of the Contractor and Owner for resolution. The CxA will have no authority to direct changes or corrections to the system. Observation reports shall be published to the Owner, Architect and Contractor and shall be part of the final commissioning manual.

1.8 OPERATIONAL AND START-UP TESTS

- A. The CxA shall witness start-up tests and collect documentation of the tests. The CxA shall notify the Architect and Contractor of any deviations from the contract documents. Any deviations shall be corrected or accepted by the Owner prior to acceptance.
- B. After the Contractor has submitted in writing that the systems are completed, the CxA shall schedule and direct operational tests of the systems. These tests shall be as described in Section 23 08 00. The results shall be documented and made part of the commissioning manual. Any deviations from the design shall be brought to the attention of the Architect and Contractor. Any deviations shall be corrected or accepted by the Owner prior to acceptance.

1.9 COMMISSIONING MANUAL

- A. The CxA shall prepare the final commissioning manual. The manual shall provide a complete history of the commissioning process and shall include:
 - 1. Design and Energy Codes.
 - 2. Commissioning Plan.
 - 3. Completed Commissioning Forms.
 - 4. Completed Observation Reports.
 - 5. Completed Start-up Reports.
 - 6. System Operational Tests.
 - 7. Final sequence of operation to be achieved.
 - 8. Summary of building operation as commissioned, noting deviations from design.
 - 9. Design Criteria (extended from Design Documents by CxA).

10. Written summary of normal startup and operating procedures for each commissioned item of equipment.

The manual shall be a three ring binder with tabs for each section. Provide 5 copies.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION 23 08 01

SECTION 23 31 13 - DUCTWORK

PART 1 - GENERAL

1.1 INDUSTRY STANDARDS

- A. Construct ductwork to meet all functional criteria defined in Section 11 of the current edition of the SMACNA "HVAC Duct Construction Standards, Metal and Flexible" code. Comply with SMACNA recommendations for fabrication, construction and details, and installation procedures, except as otherwise indicated.
- B. Comply with American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), except as otherwise indicated.
- C. Comply with SMACNA "HVAC Air Duct Leakage Test Manual" for testing of duct systems.

1.2 SUBMITTALS

- A. Detailed ductwork shop drawings, which include sizes, layouts, and pressure classifications, must be properly submitted. Any ductwork installed without prior written approval by the engineer of record shall be replaced at the expense of the contractor.
- B. Shop Drawings: Submit shop drawings for:
 - 1. Transition elbows.
 - 2. Seal and reinforcing schedule for all ductwork fabrication types.
 - 3. Turning vane and turning vane installation.
- C. Product Data: Submit manufacturer's product data on the following:
 - 1. Duct lining.
 - 2. Duct lining adhesive.

PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS

- A. All interior ducts shall be constructed with G-90 or better galvanized steel (ASTM A653/653M) LFQ, chem treat. Exterior ductwork or duct exposed to high humidity conditions (i.e., kitchen exhausts) shall also be G-90 or better galvanized steel LFP, chem treat.
- B. Stainless-steel duct shall be fabricated from lock forming grade, 300 series, ASTM-AI67, No. 4 general purpose finish. Protect finish with mill applied adhesive protective plastic/paper throughout construction.

- C. Ungalvanized carbon steel shall be lockforming grade, hot rolled steel conforming to ASTM A366 or A619.
- D. Ductwork designated for painting (by Others) shall be provided with “Paint Lock” finish to accept primer and paint. See Architectural and mechanical documents for designated locations.

2.2 RECTANGULAR DUCT

- A. Construct rectangular ductwork to meet all functional criteria defined in Section 11, of the SMACNA “HVAC Duct Construction Standards Metal and Flexible” Current Edition. All ductwork must comply with all local, state and federal code requirements.
- B. Where the standard allows the choice of external reinforcing or internal tie rods, only the external reinforcing options shall be used.
- C. Pittsburgh lock shall be used on all longitudinal seams. All longitudinal seams will be sealed with mastic sealant. Snaplock is not acceptable.
- D. Ductmate or W.D.C.I. proprietary duct connection systems will be accepted. Duct constructed using these systems will refer to the manufacturers guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.
- E. Formed on flanges (T.D.C./T.D.F./T-25A/T-25B) shall be constructed as SMACNA T-25 flanges, whose limits are defined on Page 2.76 2005 SMACNA Manual, Current Edition. No other construction pertaining to formed on flanges will be accepted. Formed on flanges shall include the use of corners, bolts and cleat.
- F. Ductmate type systems that use a butyl Rubber Gasket which meets Mil-C 18969B, Type II Class B, TT-C-1796 A, Type II Class B, and TTS-S-001657 must also pass UL-723. This material, in addition to the above, shall not contain vegetable oils, fish oils, or any other type vehicle that will support fungal and/or bacterial growth (as defined in 21CFR 177, 1210 closures with sealing gaskets for food containers).
- G. Fittings shall be constructed and reinforced as ductwork according to the longest span.

2.3 ROUND AND OVAL DUCT

- A. Round and oval duct shall be galvanized steel, constructed in accordance with Section 11 of the current edition of the SMACNA “Duct Construction Standards, Metal and Flexible” code, except as noted.
 - 1. Lighter gauge factory made duct with an Intermediate standing rod may be used. Submit product data sustaining the equivalency of such duct into SMACNA standard duct.
- B. Minimum duct gauge shall be 26 gauge.

- C. Round ductwork shall be spiral lock seam construction only. Longitudinal seam duct is not acceptable. Gauges shall be in accordance with SMACNA Duct Construction Standard and fittings in accordance with SMACNA Duct Construction Standard, except as noted:
1. Joints 0"-20" diameter, interior slip coupling beaded at center, fastened to duct with sealing compound applied continuously around joint before assembling and after fastening. Wrap joints with 3-inch wide duct tape.
 2. Joints 21"-72" diameter, use 3-piece, gasketed, flanged joints consisting of 2 internal flanges (with integral mastic sealant) split to accommodate minor differences in duct diameter, and one external closure band designed to compress gasketing between internal flanges. Example: Ductmate Spiralmate or equal.
 3. Joints 73" diameter and up, use companion angle flanged joints only as defined on page 3-6 of the SMACNA Manual. Refer to manual for proper sizing and construction details. Ductwall to be welded longitudinal seams.
- D. Fittings shall be continuously welded, standing seam, or spot welded and sealed. Metal thickness and reinforcing shall be equivalent to the requirements of the largest span.
1. All elbows greater than 45" shall be radius type, $R=1.5$ times duct diameter.
 2. Elbows less than 6" shall be of die stamped construction. Elbows 6" or greater shall be 5-gore construction.
 3. Diverging and converging flow fittings shall be constructed with no excess material projecting from the body into the branch tap entrance. All such fittings shall be 45° "shoe" entrance, wye plus elbow, or 45° lateral branch. Special fittings such as heel tapped elbows and bullhead tees may be used only where shown on drawings. Adjustable elbows and straight saddle taps shall not be used. Low pressure adjustable elbows acceptable.
- E. Where round ductwork 24" and smaller is indicated to be in areas exposed to view, utilize one of the following transverse joining methods:
1. Beaded sleeve connections with duct sealant applied to the sleeve joint prior to attachment.
 2. Beaded sleeve connections with gasket integral to sleeve.
- No sealant shall be visible on the outside of the duct.

2.4 MISCELLANEOUS DUCTWORK MATERIALS

- A. General: Provide miscellaneous materials and products of the types and sizes indicated, and where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.
- B. Double wall turning vanes shall be Harper double wall turning vanes fabricated from the same material as the duct. Tab spacing shall be SMACNA standard. Rail systems with non-standard tab spacings shall not be accepted. All tabs shall be used, do not skip tabs. Mounting rails shall have friction insert table, which align the vanes automatically. Vanes shall be subjected to tensile loading and be capable of supporting 250 lbs., when fastened per the manufacturer's instructions. Approved Systems: Ductmate PRO-Rail.

- C. Single wall splitter and turning vanes shall be custom fabricated as specified below.
- D. Ductwork Support Materials: Except as otherwise indicated, provide galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.
 - 1. Design Basis: Power-Strut Aickinstrut
 - 2. Other Acceptable Manufacturers: None
- E. **Type FDL – Fiberglass Duct Liner:**
 - 1. Manufacturers:
 - a. Certainteed
 - b. Johns Manville
 - c. Knauf
 - d. Owens Corning
 - 2. Model: Johns Manville Linacoustic RC with Permacoat (EPA registered antimicrobial coating), in accordance with UL 181, ASTM C1071, G21 and G22 with no observed growth.
 - 3. Compliances:
 - a. FSHH-1-545, Type I
 - b. NFPA 90-A
 - 4. Roughness: 0.0008 feet
 - 5. Noise Reduction Coefficient: 0.85 or higher for 1-1/2” liner
 - 6. Round Duct Liner: Spiracoustic Plus “snap-in” type with Permacote.
- F. **Type FCCL – Flexible Closed Cell Duct Liner:**
 - 1. Manufacturers:
 - a. Aerocell AP Armaflex
 - b. Aeroflex Aerocel
 - c. K-Flex Duct Liner
 - 2. Model: Aerocell AP Armaflex with Microban antimicrobial protection (EPA registered antimicrobial coating), in accordance with UL 181, ASTM C1071, G21 and G22 with no observed growth.
 - 3. Compliances:
 - a. ASTM E 84
 - b. ASTM C 534, Type II
 - c. ASTM C 1534
 - d. NFPA 90-A
 - 4. Round Duct Liner: AP Coilflex meeting all required duct liner compliance requirements.
- G. Duct Liner Adhesive:
 - 1. Manufacturers:
 - a. Childers CP-127 Chil-Quik
 - b. CL Ward Duct Liner Adhesive

- c. Design Polymerics DP 2500
 - d. Ductmate Industries, Inc. Gecko Glue
 - e. Hercules Industries MTA500
- 2. Description: Water based.
 - 3. UL Listings: UL 723/ASTM E84.

H. Duct Sealant:

- 1. Manufacturers:
 - a. Childers CP-146 Chil-Flex
 - b. CL Ward S Seal
 - c. Design Polymerics 1010
 - d. Ductmate PROseal
 - e. Hercules Industries MTS200
- 2. Description: Non-hardening, water based, liquid or mastic elastic sealant with UV inhibitors for outdoor use
- 3. UL Listings: UL 181B-M and UL 723/ASTM E84.
- 4. Sealants shall contain no VOCs.

I. Duct Tape Sealing System:

- 1. Manufacturers:
 - a. Design Polymerics
 - b. Hardcast.
 - c. Approved equal
- 2. Model:
 - a. Tape: Hardcast DT
 - b. Indoor Adhesive: Hardcast FTA-20
 - c. Outdoor Adhesive: Hardcast RTA-50

J. Acoustical Duct Lagging:

- 1. Manufacturers:
 - a. Acoustical Solutions
 - b. Kinetics Noise Control
 - c. Sound Seal
- 2. Model: Sound Seal B-10 LAG/QFA-3, foil face loaded vinyl or lead barrier sheet fully bonded to a minimum 1" thick fiberglass blanket, nominal density of 1.0psf, install so jacket edges overlap by minimum of 6", minimum STC-27 tested by independent laboratory in accordance with ASTM E90 and E413, minimum insertion loss (IL) value at 500Hz shall be 23 and meets IMC flame/smoke ratings in accordance with ASTM E84.

K. Fiberglass ductboard is not accepted without prior written approval from the specifier.

- L. Access doors shall be hinged or Ductmate Sandwich Type Access Doors manufactured by Ductmate Industries, Inc. Doors shall be of adequate size to allow easy access to hardware, which needs to be maintained.
- M. Flexible Duct Connector:
1. Flexible duct connector shall be used where ductwork connects to fans of apparatus, or apparatus casing to fans.
 2. Connectors will meet NFPA 90A and 90B specifications and provide an airtight and waterproof seal.
 3. Indoor installations shall be Neoprene or vinyl coated fabrics.
 4. Outdoor installations shall use Hypalon coated fabric.
 5. Connector shall be Ductmate PROFlex or approved equal.

2.5 FABRICATION

- A. Construct rectangular ductwork to meet all functional criteria defined in Section VII, of the SMACNA "HVAC Duct Construction Standards Metal and Flexible" Current Edition. This shall be subsequently referred to as the SMACNA Manual. All ductwork must comply with all local, state and federal code requirements.
- B. All ductwork shall be constructed to meet the following SMACNA Pressure Class as determined by the associated fan system external static pressure. Refer to air handler and fan schedules for external static pressure requirements.

	Fan System External Static Pressure					
	0" to 2" w.c.		Above 2" to 4" w.c.		Above 4" to 6" w.c.	
	SMACNA Duct Pressure Class	Test Pressure	SMACNA Duct Pressure Class	Test Pressure	SMACNA Duct Pressure Class	Test Pressure
Positive Pressure Ductwork (Supply, Exhaust/Return downstream of fan, etc.)	2" w.c. (Note 4)	2.5" w.c. (Note 4)	4" w.c.	5" w.c.	6" w.c.	7.5" w.c.
Negative Pressure Ductwork (Return, Exhaust, etc.)	-2" w.c. (Note 5)	-2.5" w.c. (Note 5)	-4" w.c.	-5" w.c.	-6" w.c.	-7.5" w.c.

Notes:

1. Refer to air handling unit and fan schedules for fan system external static pressure.
2. Duct systems shall be constructed to the SMACNA Duct Pressure Class as indicated in the table above.

3. Duct system pressure testing, where required, shall be conducted to no higher than the test pressures indicated in the table above.
 4. In supply air systems with airflow control devices (VAV boxes, fan-powered VAV boxes, venturi air valves, etc.), positive pressure ductwork between the fan and the airflow control device shall be constructed to 4" w.c. SMACNA Duct Pressure Class with test pressure of 5" w.c.
 5. In return or exhaust air systems with airflow control devices (VAV boxes, venturi air valves, etc.), negative pressure ductwork between the fan and the airflow control device shall be constructed to -4" w.c. SMACNA Duct Pressure Class with test pressure of -5" w.c.
- C. Make all changes in direction using 1.5 radius elbows where possible. Use splitter vanes or mitered rectangular elbows with turning vanes otherwise.
1. Use single thickness splitter vanes for all radius elbows less than $1.5 D = r$.
 - a. D = diameter of duct or width of duct (in plane of change-in-direction).
 - b. r = radius of duct at duct center-line.
 - c. Use "Curve Ratios" of 0.45 or greater (as defined by figure 3-7 of the 1989 ASHRAE Fundamentals Handbook).
 2. Use single thickness turning vanes with no trailing edges in accordance with SMACNA Standards.
 - a. All mitered, rectangular elbows in series.
 - b. All mitered, rectangular elbows less than 36" in width (in plane of change-of-direction).
 3. Use double width, airfoil type turning vanes with no trailing edges for all rectangular elbows greater than 36" in width (in plane of change-of-direction).
 - a. Isolated elbows have a minimum of 3D straight duct upstream and downstream of the change-in-direction.
 4. Transfer air elbows are not required to use turning vanes.
- D. Fabricate transition elbows with turning vanes at correct angle so entering and leaving edges are parallel or tangent to air flow.
- E. All branch duct take-offs shall use 45° laterals or 45° "pants-leg" type fittings.

PART 3 - EXECUTION

3.1 INSTALLATION OF DUCTWORK

- A. Assemble and install ductwork in accordance with recognized industry practices, which will achieve air-tight and noiseless systems, capable of performing each indicated service.
- B. Install each run with a minimum of joints.

- C. Where ducts pass expansion joints or structural elements subject to movement provide flexible connections and supports to allow for movement without adverse effects.
- D. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth.
- E. Support ducts rigidly with suitable ties, braces, hangers and anchors of the type, which will hold ducts true-to-shape to prevent buckling. This Division is responsible for all duct supports.
- F. Seal ducts in accordance with SMACNA requirements for pressure class indicated. Refer to duct leakage testing requirements for required seal class.
 - 1. Indoor Ducts: Use liquid or mastic sealant, or tape system.
 - 2. Outdoor Ducts: Use tape system.
 - 3. Approved manufactured joining systems with gaskets may be used in lieu of transverse sealing.
- G. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible.
- H. Hold ducts close to walls, overhead construction, columns, and other structural and permanent-enclosure elements of the building.
 - 1. Limit clearance to 0.5" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any.
 - 2. Where possible, locate insulated ductwork for 1.0" clearance outside of insulation.
- I. In finished spaces, conceal ductwork by locating in mechanical shafts, hollow wall construction or above suspended ceilings.
- J. Where possible, avoid locating ducts on or near floor.
 - 1. Where ducts must be located low, provide metal trestle to protect duct at places where duct will be climbed over.
- K. Coordinate the layout with suspended ceiling and lighting layouts and similar finished work.
- L. Install access doors where necessary for inspection and maintenance.
 - 1. Provide additional 12" x 12" access door at each low leakage damper.
 - 2. Arrange access doors so that:
 - a. They open against the system air pressure wherever feasible.
 - b. Their latches are operable from either side, except where the duct is too small to be entered.
 - 3. Provide access doors at all fire damper locations.

- M. Where ducts pass through non-fire-rated interior partitions below ceiling and exterior walls:
 - 1. Conceal the space between the construction opening and the duct or duct-plus-insulation with sheet metal flanges of the same gauge as the duct.
 - 2. Overlap the opening on all sides by at least 1-1½”.
- N. Provide volume dampers at branch take-offs (except upstream of VAV boxes which should not have dampers).
- O. Provide conical or tapered taps on all round ductwork takeoffs. Balancing dampers may be integral to conical or tapered tap fittings.
- P. Where space permits, round or oval ductwork of equivalent diameter may be substituted for unlined rectangular ductwork.
- Q. Do not modify ductwork in a manner that will increase external static pressure in the system without written approval from Architect/Engineer.

3.2 DUCT LINER INSTALLATION

- A. Refer to Application Schedule, 23 07 00.
- B. Ductwork shall be insulated per Section 23 07 00. See Section 23 07 00 for additional insulation requirements on unlined and/or uninsulated ductwork.
 - 1. Coordinate lined duct and insulated duct prior to bid.
- C. Seal all exposed ends of liner with duct liner adhesive back a minimum of 2” from ends. Seal all joints in liner a minimum of 1” overlap. Seal all fasteners.
- D. Completely remove any loose material from each section of lined ductwork as it is installed.
- E. Dimensions indicated on plans show inside free area.

3.3 DUCT LEAKAGE TESTING

- A. Installed ductwork shall be tested prior to installation of access doors, take-offs, etc.
- B. All leak testing shall be witnessed by the Engineer or representative of the Engineer. The Contractor shall give the Engineer 72 hours’ notice prior to testing. Any testing not witnessed by the Engineer or their representative, shall be considered invalid and will be redone.
- C. The testing shall be performed as follows:
 - 1. Perform testing in accordance with HVAC Air Duct Leakage Test Manual.
 - 2. Use a certified orifice tube for measuring the leakage.
 - 3. Define section of system to be tested and blank off.
 - 4. Determine the percentage of the system being tested.
 - 5. Using the percentage, determine the allowable leakage (cfm) for that section being tested.

6. Pressurize to operating pressure and repair any significant or audible leaks.
 7. Repressurize and measure leakage.
 8. Repeat steps 6 and 7 until the leakage measured is less than the allowable defined in step 5.
- D. All transverse joints and longitudinal seams shall conform to SMACNA's Class A sealing requirements as defined on page 1.17 in the current edition of the SMACNA Manual.
- E. Variable Air Volume Systems/Supply Ductwork
- | | |
|------------------------|------------------|
| Fan to VAV Boxes | 1% of design cfm |
| VAV Boxes to Registers | 2% of design cfm |
- F. Variable Air Volume Systems/Return Ductwork
- | | |
|-------------------|------------------|
| Allowable Leakage | 2% of design cfm |
|-------------------|------------------|
- G. Exhaust Systems 1% of design cfm
- H. Extent of Testing
1. Test all sheet metal located within shaft wall construction or concealed behind walls.
 2. Test the first 25 percent of duct area of each individual fan system on the project. Testing shall begin at the supply fan or air handling unit discharge for supply air systems or at the exhaust fan or return fan intake for exhaust or return air systems. If all individual fan systems show leakage levels at or below those listed above, remaining ductwork will be permitted to be visually inspected.
 3. At Engineer's discretion up to 5 additional tests at random system points may be required.
 4. Submit duct testing reports for each individual fan system to Engineer for record.

3.4 DUCTWORK STORAGE AND CLEANING

- A. Cleaning:
1. Interior surfaces shall be free of dust and debris prior to initial startup. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes. Any cleaning of duct systems shall comply with recommendations of NAIMA and NADCA.
 2. When internally cleaning duct work prior to installation or shipment to the jobsite, all duct ends and openings must be covered prior to transporting with a dual Polyethylene protective film. Film must be securely affixed to protect against dirt and debris and must be translucent to facilitate inspection of interior surfaces without removing film. Film must have a minimum elongation of 600%, contain no VOC and leave no residue on duct after removal.
 3. Clean external surfaces of foreign substances that might cause corrosion, deterioration of the metal, or where ductwork is to be painted.

B. Protection:

1. Store duct a minimum of 4" above ground or floor to avoid damage from weather or spills.
2. Cover all stored ducts to protect from moisture or debris.
3. Cover all ends of installed ductwork at the end of each workday or when dust and debris producing construction (such as fire proofing, drywall, sanding, or core drilling) is occurring.

C. Ductwork contaminated or damaged above "shop" or "mill" conditions shall be cleaned, repaired or replaced to the Engineer's satisfaction.

1. Ductliner pre-installed in stored duct which has become wet may be installed if first allowed to completely dry out.
2. Ductliner in installed ductwork, which has become wet must be completely removed and replaced.
3. Torn ductliner may be replaced by coating with adhesive if damaged is minor and isolated. Extensively damaged liner shall be replaced back to a straight cut joint.

END OF SECTION 23 31 13

SECTION 23 33 00 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 INDUSTRY STANDARDS

- A. Comply with SMACNA (Sheet Metal and Air Conditioning Contractors' National Association) latest recommendations for fabrication, construction and details, and installation procedures, except as otherwise indicated.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data on the following:
1. Flexible duct

PART 2 - PRODUCTS

2.1 FLEXIBLE DUCT ACOUSTICAL

- A. Manufacturers:
1. Flexmaster Type 1M/1B
 2. ThermaFlex Type M-KE/G-KM
- B. Construction:
1. PE Liner film mechanically locked without adhesives.
 2. Insulation: Minimum 1-1/2" thick fiberglass blanket with a polyethylene vapor barrier. Map 0.23 'c' factor, factory installed.
 3. Helix: Corrosion resistant galvanized steel.
- C. Pressure rating: 4" w.g. positive, 1" w.g. negative at maximum 180°F operating temperature.
- D. Standards: NFPA90A UL-181, Class I, ASTM E-96 - Procedure A.
- E. Insertion loss shall be at least:

	OCTAVE BAND (Hz)					
Duct Size	125	250	500	1000	2000	4000
8"	5.6	10.6	23.9	34.0	22.5	17.0
12"	6.6	27.8	22.8	29.0	18.7	10.9
DB reduction for 6-foot length, straight route, 500 fpm.						

2.2 MISCELLANEOUS DUCTWORK ACCESSORIES

- A. Duct Access Doors: Provide duct access doors with gaskets, door hinge, and with insulation where ductwork is indicated to be insulated.

1. Manufacturers:
 - a. Greenheck
 - b. Ductmate
 - c. Elmdor
 - d. Flexmaster
 - e. Milcor
 - f. Ruskin

- B. Flexible Connectors:

1. Manufacturers:
 - a. Cain Thermolon
 - b. Carlisle Connector Plus w/Silicone Hi-T
 - c. Duro-Dyne Thermafab
 - d. Ductmate PROFlex with Silicone
2. Material: Glass fabric with silicone coating.
3. Rating: ASTM E84 or UL 723
 - a. ASTM E84
 - 1) Flame Spread less than 25
 - 2) Smoke Developed less than 50

2.3 BALANCING DAMPERS

- A. Construction:

1. Frame: 16-gauge galvanized steel.
2. Blades: 16-gauge galvanized steel with vinyl edge seals.
3. Bearings: Heavy duty nylon.
4. Performance:
 - a. Maximum pressure drop in full open position (@3000 fpm): 0.55
 - b. Maximum leakage: 32 cfm/sp at 4" W.C.

- B. Type: Rectangular balancing dampers are to be opposed blade type with locking handle, unless otherwise noted.

PART 3 - EXECUTION

3.1 INSTALLATION OF ACCESSORIES

- A. Install access doors where necessary for inspection and maintenance.
 - 1. Provide additional 12" x 12" access door at each low leakage damper.
 - 2. Arrange access doors so that:
 - a. They open against the system air pressure, wherever feasible.
 - b. Their latches are operable from either side, except where the duct is too small to be entered.
 - c. Install flexible connectors at all duct connections to rotating or reciprocating machinery or equipment.
 - 3. Provide access doors at all fire damper locations.
- B. Install flexible ductwork without tight bends and free of kinks.
 - 1. Flexible ductwork shall not be less than 4', nor exceed 8' in length.
 - 2. Flexible ductwork shall be installed with a "minimum length of straight duct" upstream of the diffuser neck inlet. "A minimum length" shall mean a length equal to three (3) duct diameters. "Straight duct" shall mean the center-line of the duct shall be aligned with a line perpendicular to the plane of the diffuser neck opening at the center point of the opening.
 - 3. Flexible ductwork shall be installed with a maximum of 135 degrees of total turning in entire length of flexible duct. Minimum turning radius shall be 1.5 x diameter to centerline of duct.
 - 4. Conform to the detail on the drawings.
- C. Install all dampers, including those furnished by Section 23 09 00 Contractor.
 - 1. Caulk damper frames to ductwork.
 - 2. Make sure dampers are free to operate properly.
 - 3. Install parallel blade mixing dampers to two streams impinge on each other to facilitate mixing.
- D. Provide balance dampers at branch take-off and where required to minimize balancing performed at diffuser face.
- E. Provide all balance dampers as shown on plans and any additional dampers necessary to provide a balanced system meeting all sound requirements.

END OF SECTION 23 33 00

SECTION 23 37 00 - AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 CEILING CONSTRUCTION

- A. Provide products compatible with ceiling construction.

1.2 SUBMITTALS

- A. Submit catalog data including throw, sound, pressure drop and physical dimensions.

1.3 INDUSTRY STANDARDS

- A. Provide products tested in accordance with ASHRAE 70-1991 150 Standard 5219, 150 Standard 3741.

PART 2 - PRODUCTS

2.1 GRILLES AND RECTANGULAR DIFFUSERS

- A. Manufacturers:
 - 1. Krueger
 - 2. Metal Aire
 - 3. Nailor
 - 4. Price
 - 5. Titus
- B. Material: Steel or aluminum except:
 - 1. Where noted otherwise.
 - 2. Where required otherwise for fire rating.
 - 3. Grilles and diffusers in locker rooms, showers and toilet rooms in locker rooms to be aluminum.
- C. Finish: Baked white enamel except where noted.
- D. Refer to the Drawings for required performance.
- E. Match frame and border types to ceiling system.

2.2 SLOT DIFFUSERS WITH FACTORY-SUPPLIED PLENUMS

- A. Manufacturers:
 - 1. Krueger
 - 2. Metal Aire
 - 3. Nailor
 - 4. Price
 - 5. Titus
- B. Material: Steel or aluminum except:
 - 1. Where noted otherwise.
 - 2. Required otherwise for fire rating.
- C. Finish: Baked white enamel except where noted.
- D. Inlet Size: Match duct size.
- E. Match frame and border types to ceiling system.

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to architectural reflected ceiling plan for exact locations and ceiling types.
- B. Provide all support and framing devices necessary.
- C. Exposed mounting screws:
 - 1. Use tamper proof screws in countersunk holes.
 - 2. Point screws to match frame.
- D. Install security type devices in accordance with manufacturer's directions.

END OF SECTION 23 37 00

SECTION 23 90 00 - PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The contractor shall summarize and document adherence with the requirements of the specifications for project closeout including:
 - 1. Copies of all warranties
 - 2. Operation & Maintenance Manuals
 - 3. Required tests
 - 4. Test and balance reports
 - 5. Record drawings
 - 6. Permit requirements
 - 7. Valve tag list
- B. The contractor shall compile a closeout manual which shall include:
 - 1. A list of all required tests and a place for signoff of date completed.
 - 2. A list of all submittals with dates of acceptance by the engineer.
 - 3. A schedule indicating dates for beginning testing and startup of equipment and dates of tests to be witnessed by the engineer, or designated representative, as required by the specifications.
 - 4. Test procedures to be used for life safety systems.
 - 5. Project close out check list.
- C. The final closeout manual shall include the following:
 - 1. Test reports as required by the specifications with signoff by the appropriate individual (engineer, architect, building official, etc.).
 - 2. Documentation indicating all equipment is operating properly and is fully accessible for maintenance.
 - 3. Copies of all warranties.
 - 4. Test and Balance report.
- D. This section only includes the requirements for documentation of the contract documents, by the contractor, for project completion. This section does not in any way decrease the scope of any of the drawings or specifications.

1.2 SUBMITTALS

- A. Within 90 days after notice to proceed submit a preliminary closeout manual with the following:
 - 1. A list of all required tests.

2. Preliminary schedule showing major milestones for completion of the mechanical/plumbing systems.
- B. Within 30 days of substantial completion submit the completed closeout manual as described in Part 1.
- C. Within 2 weeks of substantial completion submit a completed "Project Closeout Check List", and the Final Closeout Manual.
- D. Listed below is a checklist for use by the contractor. This list is not all inclusive for this project.

Project Close-Out Summary – Mechanical, Plumbing and Fire Protection

- ☐ All required submittals have been cleaned, submitted and either been approved or modified in accordance with the Engineer's "make corrections noted" comments. Our records indicate the following submittals are still outstanding:
- ☐ Clean filters installed in all units. (Install just prior to building turnover)
- ☐ All equipment has been started up and is functioning within manufacturers' recommendations without any undue noise or vibration. (Submit a list of equipment with startup dates. Provide list no later than 120 days prior to project completion date).
- ☐ All vibration isolation has been installed and is operating properly.
- ☐ Duct access doors have been installed at fire and fire/smoke dampers and are properly fire-stopped and fire and fire/smoke dampers have been visually inspected to confirm that they are open.
- ☐ Access doors have been installed as required for concealed equipment, water hammer arrestors, valves, controls, actuators, etc.
- ☐ All ductwork and piping are labeled per specifications.
- ☐ All plumbing piping cleaned, flushed and tested per specifications. Submit testing reports for record. Submit letter stating domestic water disinfection (chlorination) has been completed per the specifications.
- ☐ All action items are complete as listed in the action items reports. Submit a list of action items with sign off by Architect or Engineer for record. Punch list to be completed prior to turn over of building.
- ☐ Temperature control system complete and tested per specifications.
- ☐ Test and balance complete and report submitted and accepted by Engineer.
- ☐ Fire sprinkler system and pump tested per specifications.
- ☐ Operation and maintenance manuals submitted with table of contents and required documentation for extended warranties.
- ☐ Factory Testing documented and submitted for record.
- ☐ Record drawings submitted per specifications.
- ☐ Temperature Control record documents provided per specifications.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 EQUIPMENT STARTUP AND TESTING

- A. Prior to completion and punchlist by the engineer, the contractor shall startup and test each piece of equipment as required by the specifications. The contractor shall provide documentation of all required tests with signoff of by the appropriate individual (engineer, architect, and building official).

3.2 COORDINATION WITH OTHERS

- A. The Division 21 through 23 contractor shall coordinate their requirements with the General Contractor to ensure the other building systems are completed to the point that they will not adversely affect the operation of the Division 21 through 23 systems.

3.3 PUNCH LISTS

- A. The contractor shall submit in writing that the project is ready for final review by the engineer.
- B. Once the project is ready for final review the engineer will create a punch list of any corrections or deficiencies.
- C. The contractor shall complete all punch list items and provide a letter to the architect after completion stating all items have been completed or reasons why they were not completed.
- D. Upon receipt of this letter the engineer will verify that the punch list has been satisfactorily completed.

END OF SECTION 23 90 00

SECTION 260010 - SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies supplemental requirements generally applicable to the Work specified in Division 26. This Section is also referenced by related Work specified in other Divisions.
- B. Related Requirements:
 - 1. Section 260011 "Facility Performance Requirements for Electrical" specifies seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 REFERENCES

- A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:
 - 1. 2S2W: TWO SPEED TWO WINDING
 - 2. 2SR2W: TWO SPEED REVERSING TWO WINDING
 - 3. 8P8C: An 8-position 8-contact modular jack.
 - 4. A or AMPS: Ampere, unit of electrical current.
 - 5. AC or ac: Above Counter or Alternating current.
 - 6. AF: Ampere Frame (Circuit Breaker)
 - 7. AFCI: Arc-fault circuit interrupter.
 - 8. AFF: Above Finished Floor
 - 9. AFG: Above Finished Grade
 - 10. AFU: Ampere Fure
 - 11. AHU: Air Handling Unit
 - 12. AIC: Ampere interrupting capacity.
 - 13. AL, Al, or ALUM: Aluminum.
 - 14. AM: Ammeter
 - 15. AS: Ammeter Switch
 - 16. ASD: Adjustable-speed drive; also called "variable-frequency drive" (VFD).
 - 17. AT: Ampere Trip (Circuit Breaker)
 - 18. ATS: Automatic transfer switch.
 - 19. AUX: Auxiliary
 - 20. A/V: Audio Visual
 - 21. AWG: American wire gauge; see ASTM B258.
 - 22. BAS: Building automation system.
 - 23. BAT, BATT: Battery
 - 24. BC or bc: Below Counter or Bonding conductor
 - 25. BFG: Below Finished Grade BIL: Basic impulse insulation level.

- 26. BIL: Basic impulse insulation level.
- 27. BIM: Building information modeling.
- 28. BKR: Breaker
- 29. BLDG: Building
- 30. BP: Bypass
- 31. C: Conductor or Conduit
- 32. CDT: Conduit
- 33. CAB: Cabinet
- 34. CAD or CADD: Computer-aided design or drafting.
- 35. CATV: Community antenna television, (Cable Television).
- 36. CB: Circuit breaker.
- 37. CCT: Correlated Color Temperature
- 38. CCTV: Closed Circuit Television
- 39. CKT: Circuit
- 40. CLG: Ceiling

- 41. cd: Candela, the SI fundamental unit of luminous intensity.
- 42. CO: Conduit Only
- 43. CO/ALR: Copper-aluminum, revised.
- 44. COAX: Coaxial Cable
- 45. COL: Column
- 46. COMM: Communications
- 47. CONN: Connection
- 48. COPS: Critical operations power system.
- 49. CP: Control Panel
- 50. CPT: Control Panel Tranformer
- 51. CPU: Central Processing Unit
- 52. CR: Card Reader
- 53. CRI: Color Rendering Index
- 54. CRT: Cathode Ray Tube Monitor
- 55. CS: Control Switch
- 56. CT: Current Transformer, Cooling Tower
- 57. CU or Cu: Copper.
- 58. CU-AL or AL-CU: Copper-aluminum.
- 59. CUH: Cabinet Unit Heater
- 60. D: Depth, Dimming
- 61. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
- 62. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
- 63. dB(adjusted) or dBa: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).
- 64. dBm: Decibel absolute power with respect to 1 mW.
- 65. DC or dc: Direct current.
- 66. DCOA: Designated critical operations area.
- 67. DDC: Direct digital control (HVAC).
- 68. DEMO or (D): Demolition
- 69. DIA: Diameter
- 70. DIM: Dimming

- 71. DISC: Disconnect
- 72. DIST: Distribution
- 73. DN: Down
- 74. DPDT: Double-Pole, Double-Throw
- 75. DPST: Double-Pole, Single-Throw
- 76. DWG: Drawing
- 77. E: Electric / Emergency
- 78. EC: Electrical Contractor, Empty Conduit
- 79. EF: Exhaust Fan
- 80. EL: Elevation
- 81. ELEC, ELECT: Electrical
- 82. ELEV: Elevator
- 83. EGC: Equipment grounding conductor.
- 84. ELV: Extra-low voltage.
- 85. EM: Emergency
- 86. EMF: Electromotive force.
- 87. EMI: Electromagnetic interference.
- 88. EMT: Electrical Metallic Tubing
- 89. EO: Electrically Operated
- 90. EOL: End of Line Device
- 91. EPM: Electrical preventive maintenance.
- 92. EPO: Emergency Power Off
- 93. EPS: Emergency power supply.
- 94. EPSS: Emergency power supply system.
- 95. EQ: Equal
- 96. EQUIP: Equipment
- 97. ER, (ER): Existing to be Relocated
- 98. ESS: Energy storage system.
- 99. EST: Estimated
- 100. EV: Electric vehicle.
- 101. EVPE: Electric vehicle power export equipment.
- 102. EVSE: Electric vehicle supply equipment.
- 103. EWC: Electric Water Cooler
- 104. EX, (E): Existing to remain
- 105. F: Flush
- 106. FA: Fire Alarm
- 107. FACP: Fire Alarm Control Panel
- 108. fc: Footcandle, an internationally recognized unit of illuminance equal to one lumen per square foot or 10.76 lx. The simplified conversion 1 fc = 10 lx in the Specifications is common practice and considered adequate precision for building construction activities. When there are conflicts, lux is the primary unit; footcandle is specified for convenience.
- 109. FCC: Fire Command Center
- 110. FCU: Fan Coil Unit
- 111. FDR: Feeder
- 112. FLC: Full-load current.
- 113. FIDS: Flight Information Display
- 114. FIXT: Fixture
- 115. FLA: Full Load Amperes

- 116. FLR, FL: Floor
- 117. FO: Fiber Optic
- 118. FOPP: Fiber Optic Patch Panel
- 119. FPB: Fan Powered Box
- 120. FT, ft: Foot.

- 121. ft-cd: Foot-candle, the antiquated U.S. Standard unit of illuminance, equal to one international candle measured at a distance of one foot, that was superseded in 1948 by the unit "footcandle" after the SI unit candela (cd) replaced the international candle; see "fc,"
- 122. FU: Fuse
- 123. FUT, (F): Future
- 124. FVR: Full Voltage Reversible
- 125. FVNR: Full Voltage Non-Reversing
- 126. G, GND, GRD: Ground (Conductor)
- 127. GA: Gauge
- 128. GEC: Grounding electrode conductor.
- 129. GEN: Generator
- 130. GF: Ground Fault
- 131. GFCI, GFI: Ground-fault circuit interrupter.
- 132. GFR: Ground Fault Relay
- 133. GFPE: Ground-fault protection of equipment.
- 134. GND: Ground.
- 135. GPS: Generator Paralleling Switchgear
- 136. GRC: Galvanized Rigid Steel Conduit
- 137. HACR: Heating, air conditioning, and refrigeration.
- 138. HDPE: High-density polyethylene.
- 139. HH: Hand hole
- 140. HID: High-intensity discharge.
- 141. HOA: Hand-Off-Automatic Switch
- 142. HP or hp: Horsepower.
- 143. HT: Height
- 144. HV: High Voltage
- 145. HVAC: Heating, ventilating, and air conditioning.
- 146. HWP: Hot Water Pump
- 147. Hz: Hertz.
- 148. IBT: Intersystem bonding termination.
- 149. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
- 150. I/INST: Instantaneous
- 151. ICE: Ice Maker
- 152. ICM: Intercom Master
- 153. ICR: Intercom Remote
- 154. IG: Isolated ground
- 155. IMC: Intermediate Metal Conduit
- 156. IN: Inch
- 157. INSTR: Instrument/Instrumentation
- 158. IP: Ingress protection rating (enclosures); Internet protocol (communications).
- 159. IR: Infrared.
- 160. IS: Intrinsically safe.

- 161. IT&R: Inspecting, testing, and repair.
- 162. ITE: Information technology equipment.
- 163. JB, J-BOX: Junction Box
- 164. K: Key Lock (Key Interlock Scheme)
- 165. KA: Kiloamperes
- 166. kAIC, (KAIC): Kiloampere interrupting capacity.

- 167. kcmil, KCM, MCM: One thousand circular mils.
- 168. KEF: Kitchen Exhaust Fan
- 169. kV, KV: Kilovolt.
- 170. kVA, KVA: Kilovolt-ampere.
- 171. kVAR or kVAR: Kilovolt-ampere reactive.
- 172. kW: Kilowatt.
- 173. kWh: Kilowatt-hour.
- 174. L: Locking Type, Load
- 175. LA: Lightning Surge Arrestor
- 176. LAN: Local area network.
- 177. lb: Pound (weight).
- 178. lbf: Pound (force).
- 179. LCD: Liquid-crystal display.
- 180. LCDI: Leakage-current detector-interrupter.
- 181. LED: Light-emitting diode.

- 182. Li-ion: Lithium-ion.

- 183. lm: Lumen, the SI derived unit of luminous flux.
- 184. LNG: Liquefied natural gas.
- 185. LP: Lighting Panel
- 186. LP-Gas: Liquefied petroleum gas.
- 187. LRC: Locked-rotor current.
- 188. LT: Long Time
- 189. LTG, LTS: Lighting, Lights
- 190. LTNG: Lightning
- 191. LV: Low voltage.
- 192. lx: Lux, the SI derived unit of illuminance equal to one lumen per square meter.
- 193. M, m: Meter.
- 194. MM, mm: Millimeter, Multimode
- 195. MM2, mm2: Millimeter Squared
- 196. MAX: Maximum
- 197. MCA: Minimum Circuit Ampacity
- 198. MCB: Main Circuit Breaker
- 199. MCC: Motor-control center.
- 200. MCCB: Molded Case Circuit Breaker
- 201. MDC: Modular data center.
- 202. MDF: Main Distribution Frame
- 203. MECH: Mechanical
- 204. MFR: Manufacturer
- 205. MG set: Motor-generator set.
- 206. MGB: Main Grounding Busbar

- 207. MH: Man Hole, Mainhole, Metal Halide
- 208. MI: Mineral-Insulated
- 209. MIC: Media Interace Connector
- 210. MIDI: Musical instrument digital interface.
- 211. MIN: Minimum
- 212. MISC: Miscellaneous
- 213. MLO: Main lugs only.
- 214. MOCP: Maximum Overcurrent Protection
- 215. MPS: Manual Pull Station
- 216. MTD: Mounted
- 217. MTG: Mounting
- 218. MTS: Manual Transfer Switch
- 219. MV: Medium voltage.
- 220. MVA: Megavolt-ampere.
- 221. mW: Milliwatt.
- 222. MW: Megawatt, Microwave.
- 223. MWh: Megawatt-hour.
- 224. N: Neutral / Normal
- 225. NC: Normally closed.
- 226. NEC: National Electrical Code
- 227. NEMA: National Electrical Manufacturer's Association
- 228. NFPA: National Fire Protection Association
- 229. NIC: Not in Contract

- 230. Ni-Cd: Nickel-cadmium.

- 231. Ni-MH: Nickel-metal hydride.
- 232. NIU: Network interface unit.
- 233. NL: Night Light (Not Switched)
- 234. NO: Normally open.
- 235. NPT: National (American) standard pipe taper.
- 236. NTS: Not to Scale
- 237. NORM: Normal
- 238. NWP: Network Protector
- 239. OC: On Center
- 240. OCB: Oil Circuit Breaker
- 241. OCPD: Overcurrent protective device.
- 242. OL: Overload(s)
- 243. OS: Occupancy Sensor
- 244. ONT: Optical network terminal.
- 245. P: Pole
- 246. PA: Public Address System
- 247. PB: Pushbutton, Pull Box
- 248. PBX: Private Branch Exchange
- 249. PC: Personal computer, Photocell.
- 250. PCS: Power conversion system.
- 251. PCU: Power-conditioning unit.
- 252. PDU: Power Distribution Unit
- 253. PET: Protected Entrance Terminal

- 254. PF or pf: Power factor.
- 255. PFCC: Power Factor Correction Capacitors
- 256. PH, Ø: Phase
- 257. PHEV: Plug-in hybrid electric vehicle.
- 258. PLB, PBB: Passenger Loading (Boarding) Bridge
- 259. PLC: Programmable logic controller.
- 260. PLFA: Power-limited fire alarm.
- 261. PNL: Panel
- 262. PoE: Power over Ethernet.
- 263. PP: Power Panel
- 264. PR: Pair
- 265. PRI: Primary
- 266. PT: Potential Transformer
- 267. PV: Photovoltaic.
- 268. PVC: Polyvinyl chloride.
- 269. pW: Picowatt.
- 270. PWR: Power
- 271. QTY: Quantity, Quality
- 272. R, (R): Relocated
- 273. RR, (RR): Remove and Relocate
- 274. RE, (RE): Remove Existing
- 275. REC, RECPT: Receptacle
- 276. REF: Refrigerator
- 277. REPO: Remote E.P.O.
- 278. REQ, REQD: Required
- 279. RF: Return Fan
- 280. RFI: (electrical) Radio-frequency interference; (contract) Request for interpretation.
- 281. RIM: Reader interface Module
- 282. RLA: Running Load Amps
- 283. RM: Room
- 284. RMS or rms: Root-mean-square.
- 285. RP: Receptacle Panel
- 286. RPM or rpm: Revolutions per minute.
- 287. RTU: Remote Terminal Unit
- 288. RUPS: Rotary UPS
- 289. RVAT: Reduced Voltage Autotransformer
- 290. SCA: Short Circuit Amperes
- 291. SCADA: Supervisory control and data acquisition.
- 292. SCR: Silicon-controlled rectifier.
- 293. SD: Smoke Detector
- 294. SEC: Secondary
- 295. SF: Supply Fan
- 296. SM: Single Mode
- 297. SPD: Surge protective device.
- 298. SPEC: Specification
- 299. SPKR: Speaker
- 300. SQ, sq.: Square.
- 301. SS: Stainless Steel, Solid State

- 302. ST: Shunt Trip, Short Time
- 303. STD: Standard
- 304. STO: Switch, Thermal Overload Disconnect
- 305. STP: Shielded, Twisted Pair
- 306. STS: Static Transfer Switch
- 307. SW: Switch
- 308. SWBD: Switchboard
- 309. SWD: Switching duty.
- 310. SWGR: Switchgear
- 311. SYM: Symmetrical
- 312. SYS: System
- 313. T: Transformer
- 314. TB: Terminal Block
- 315. TBB: Telecommunications Bonding Backbone
- 316. TCP/IP: Transmission control protocol/Internet protocol.
- 317. TDR: Time Domain Reflectometer
- 318. TEF: Toilet Exhaust Fan
- 319. TEFC: Totally enclosed fan-cooled.
- 320. TEL, TELE: Telephone
- 321. TELECOM: Telecommunications
- 322. TGB: Telecommunications Grounding Busbar
- 323. TM: Thermal Magnetic
- 324. TMGB: Telecommunications Main Grounding Busbar
- 325. TOV: Toaster Oven
- 326. TR: Tamper resistant, Telephone Room.
- 327. TSTR: Toaster
- 328. TV: Television
- 329. TVSS: Transient voltage surge suppressor.
- 330. TYP: Typical
- 331. U: Utility
- 332. UC, uc: Under Counter
- 333. U/F: Under Floor
- 334. U/S: Under Slab
- 335. UG, U/G: Under Ground
- 336. UH: Unit Heater
- 337. UL: (standards) Underwriters Laboratories, Inc.; (product categories) UL, LLC.
- 338. UL CCN: UL Category Control Number.
- 339. UNO: Unless Noted Otherwise
- 340. UON: Unless Otherwise Noted
- 341. UPS: Uninterruptible power supply.
- 342. USB: Universal serial bus.
- 343. UTP: Unshielded Twisted Pair
- 344. UV: Ultraviolet.
- 345. V: Volt, unit of electromotive force.
- 346. V(ac): Volt, alternating current.
- 347. V(dc): Volt, direct current.
- 348. VA: Volt-ampere, unit of complex electrical power.
- 349. VAR: Volt-ampere reactive, unit of reactive electrical power.
- 350. VAV: Variable Air Volume Box

- 351. VEND: Vending Machine
- 352. VFC: Variable-frequency controller.
- 353. VFD: Variable Frequency Drive
- 354. VOM: Volt-ohm-multimeter.
- 355. VM: Voltmeter
- 356. VPN: Virtual private network.
- 357. VRLA: Valve regulated lead acid; also called "sealed lead acid (SLA)" or "valve regulated sealed lead acid."
- 358. VS: Voltmeter Switch
- 359. W/: With
- 360. W: Wire, Width
- 361. W: Watt, unit of real electrical power.
- 362. WCR: Withstand Current Rating
- 363. WD, WATER: Water Dispenser
- 364. Wh: Watt-hour, unit of electrical energy usage.
- 365. WM: Wattmeter
- 366. WP: Weather-Proof
- 367. WPT: Wireless power transfer.
- 368. WPTE: Wireless power transfer equipment.
- 369. WR: Weather resistant.
- 370. WT: Watertight, Weight
- 371. XP: Explosion-Proof
- 372. ZI: Zone Interlocking
- 373. ΔY: Delta-Wye

B. Abbreviations and Acronyms for Electrical Raceway Types:

- 1. CR: Communications raceway.
- 2. CR-GP: General-purpose communications raceway.
- 3. CR-P: Plenum communications raceway.
- 4. CR-R: Riser communications raceway.
- 5. EMT: Electrical metallic tubing.
- 6. EMT-A: Aluminum electrical metallic tubing.
- 7. EMT-S: Steel electrical metallic tubing.
- 8. EMT-SS: Stainless steel electrical metallic tubing.
- 9. ENT: Electrical nonmetallic tubing.
- 10. EPEC: Electrical HDPE underground conduit (thin wall).
- 11. EPEC-A: Type A electrical HDPE underground conduit.
- 12. EPEC-B: Type B electrical HDPE underground conduit.
- 13. ERMC: Electrical rigid metal conduit.
- 14. ERMC-A: Aluminum electrical rigid metal conduit.
- 15. ERMC-S: Steel electrical rigid metal conduit.
- 16. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
- 17. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
- 18. ERMC-SS: Stainless steel electrical rigid metal conduit.
- 19. FMC: Flexible metal conduit.
- 20. FMC-A: Aluminum flexible metal conduit.
- 21. FMC-S: Steel flexible metal conduit.
- 22. FMT: Steel flexible metallic tubing.

23. FNMC: Flexible nonmetallic conduit. See "LFNC."
24. HDPE: HDPE underground conduit (thick wall).
25. HDPE-40: Schedule 40 HDPE underground conduit.
26. HDPE-80: Schedule 80 HDPE underground conduit.
27. IMC: Steel electrical intermediate metal conduit.
28. LFMC: Liquidtight flexible metal conduit.
29. LFMC-A: Aluminum liquidtight flexible metal conduit.
30. LFMC-S: Steel liquidtight flexible metal conduit.
31. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
32. LFNC: Liquidtight flexible nonmetallic conduit.
33. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
34. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
35. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
36. OFR: Optical fiber raceway.
37. OFR-GP: General-purpose optical fiber raceway.
38. OFR-P: Plenum optical fiber raceway.
39. OFR-R: Riser optical fiber raceway.
40. PVC: Rigid PVC conduit.
41. PVC-40: Schedule 40 rigid PVC conduit.
42. PVC-80: Schedule 80 rigid PVC Conduit.
43. PVC-A: Type A rigid PVC concrete-encased conduit.
44. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.
45. RGS: See ERM-C-S-G.
46. RMC: See ERM-C.
47. RTRC: Reinforced thermosetting resin conduit.
48. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.
49. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
50. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
51. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
52. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.

C. Abbreviations and Acronyms for Electrical Single-Conductor and Multiple-Conductor Cable Types:

1. AC: Armored cable.
2. CATV: Coaxial general-purpose cable.
3. CATVP: Coaxial plenum cable.
4. CATVR: Coaxial riser cable.
5. CI: Circuit integrity cable.
6. CL2: Class 2 cable.
7. CL2P: Class 2 plenum cable.
8. CL2R: Class 2 riser cable.
9. CL2X: Class 2 cable, limited use.
10. CL3: Class 3 cable.
11. CL3P: Class 3 plenum cable.
12. CL3R: Class 3 riser cable.

13. CL3X: Class 3 cable, limited use.
14. CM: Communications general-purpose cable.
15. CMG: Communications general-purpose cable.
16. CMP: Communications plenum cable.
17. CMR: Communications riser cable.
18. CMUC: Under-carpet communications wire and cable.
19. CMX: Communications cable, limited use.
20. DG: Distributed generation cable.
21. FC: Flat cable.
22. FCC: Flat conductor cable.
23. FPL: Power-limited fire-alarm cable.
24. FPLP: Power-limited fire-alarm plenum cable.
25. FPLR: Power-limited fire-alarm riser cable.
26. IGS: Integrated gas spacer cable.
27. ITC: Instrumentation tray cable.
28. ITC-ER: Instrumentation tray cable, exposed run.
29. MC: Metal-clad cable.
30. MC-HL: Metal-clad cable, hazardous location.
31. MI: Mineral-insulated, metal-sheathed cable.
32. MTW: (machine tool wiring) Moisture-, heat-, and oil-resistant thermoplastic cable.
33. MV: Medium-voltage cable.
34. NM: Nonmetallic sheathed cable.
35. NMC: Nonmetallic sheathed cable with corrosion-resistant nonmetallic jacket.
36. NMS: Nonmetallic sheathed cable with signaling, data, and communications conductors, plus power or control conductors.
37. NPLF: Non-power-limited fire-alarm circuit cable.
38. NPLFP: Non-power-limited fire-alarm circuit cable for environmental air spaces.
39. NPLFR: Non-power-limited fire-alarm circuit riser cable.
40. NUCC: Nonmetallic underground conduit with conductors.
41. OFC: Conductive optical fiber general-purpose cable.
42. OFCG: Conductive optical fiber general-purpose cable.
43. OFCP: Conductive optical fiber plenum cable.
44. OFCR: Conductive optical fiber riser cable.
45. OFN: Nonconductive optical fiber general-purpose cable.
46. OFNG: Nonconductive optical fiber general-purpose cable.
47. OFNP: Nonconductive optical fiber plenum cable.
48. OFNR: Nonconductive optical fiber riser cable.
49. P: Marine shipboard cable.
50. PLTC: Power-limited tray cable.
51. PLTC-ER: Power-limited tray cable, exposed run.
52. PV: Photovoltaic cable.
53. RHH: (high heat) Thermoset rubber, heat-resistant cable.
54. RHW: Thermoset rubber, moisture-resistant cable.
55. SA: Silicone rubber cable.
56. SE: Service-entrance cable.
57. SER: Service-entrance cable, round.
58. SEU: Service-entrance cable, flat.
59. SIS: Thermoset cable for switchboard and switchgear wiring.

- 60. TBS: Thermoplastic cable with outer braid.
- 61. TC: Tray cable.
- 62. TC-ER: Tray cable, exposed run.
- 63. TC-ER-HL: Tray cable, exposed run, hazardous location.
- 64. THW: Thermoplastic, heat- and moisture-resistant cable.
- 65. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.
- 66. THHW: Thermoplastic, heat- and moisture-resistant cable.
- 67. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
- 68. TW: Thermoplastic, moisture-resistant cable.
- 69. UF: Underground feeder and branch-circuit cable.
- 70. USE: Underground service-entrance cable.
- 71. XHH: Cross-linked polyethylene, heat-resistant cable.
- 72. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Abbreviations and Acronyms for Electrical Flexible Cord Types:

- 1. SEO: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.
- 2. SEOW: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
- 3. SEOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.
- 4. SEOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
- 5. SJEO: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
- 6. SJEOW: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
- 7. SJEOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
- 8. SJEOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
- 9. SJO: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp locations.
- 10. SJOW: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
- 11. SJOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp locations.
- 12. SJOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.

13. SJTO: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.
14. SJTOW: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
15. SJTOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.
16. SJTOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
17. SO: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp locations.
18. SOW: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.
19. SOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp locations.
20. SOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.
21. STO: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.
22. STOW: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.
23. STOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.
24. STOOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.

E. Definitions:

1. Terminal Complex refers to the Main Terminal (Great Hall), Concourses, Central Utility Plant (CUP), Hotel, and the Transportation Center.
2. Basic Impulse Insulation Level (BIL): Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
3. Cable: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "cable" is (1) a conductor with insulation, or a stranded conductor with or without insulation (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).
4. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.
5. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
6. Conductor: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "conductor" is (1) a wire or combination of wires not insulated from one another, suitable for carrying an electric current; (2) (National Electrical Safety Code) a material, usually in the form of wire, cable, or bar, suitable for carrying an electric

- current; or (3) (general) a substance or body that allows a current of electricity to pass continuously along it.
7. Designated Seismic System: A system component that requires design in accordance with Ch. 13 of ASCE/SEI 7 and for which the Component Importance Factor is greater than 1.0.
 8. Direct Buried: Installed underground without encasement in concrete or other protective material.
 9. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:
 - a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
 - b. Concrete Box: A box intended for use in poured concrete.
 - c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
 - d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
 - e. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
 - f. Device Box: A box with provisions for mounting a wiring device directly to the box.
 - g. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
 - h. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
 - i. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
 - j. Floor Nozzle: An enclosure used on a wiring system, intended primarily as a housing for a receptacle, provided with a means, such as a collar, for surface-mounting on a floor, which may or may not include a stem to support it above the floor level, and is sealed against the entrance of scrub water at the floor level.
 - k. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
 - l. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.

- m. Pedestal Floor Box Cover: A floor box cover that, when installed as intended, provides a means for typically vertical or near-vertical mounting of receptacle outlets above the floor's finished surface.
 - n. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
 - o. Raised-Floor Box: A floor box intended for use in raised floors.
 - p. Recessed Access Floor Box: A floor box with provisions for mounting wiring devices below the floor surface.
 - q. Recessed Access Floor Box Cover: A floor box cover with provisions for passage of cords to recessed wiring devices mounted within a recessed floor box.
 - r. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
 - s. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
 - t. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.
10. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
11. Fault Limited: Providing or being served by a source of electrical power that is limited to not more than 100 W when tested in accordance with UL 62368-1.
- a. The term "fault limited" is intended to encompass most Class 1, 2, and 3 power-limited sources complying with Article 725 of NFPA 70; Class ES1 and ES2 electrical energy sources that are Class PS1 electrical power sources (e.g., USB); and Class ES3 electrical energy sources that are Class PS1 and PS2 electrical power sources (e.g., PoE). See UL 62368-1 for discussion of classes of electrical energy sources and classes of electrical power sources.
12. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.
13. Jacket: A continuous nonmetallic outer covering for conductors or cables.
14. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.

15. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the Energy Independence and Security Act (EISA) of 2007.
16. Multi-Outlet Assembly: A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
17. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
18. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
19. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
20. Sheath: A continuous metallic covering for conductors or cables.
21. UL Category Control Number (CCN): An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
22. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
 - a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
 - b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.
 - c. Extra-Low Voltage (ELV): Not having electromotive force between any two conductors, or between a single conductor and ground, exceeding 30 V(ac rms), 42 V(ac peak), or 60 V(dc).
 - d. Low Voltage (LV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
23. Wire: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "wire" is a slender rod or filament of drawn metal. A group of small wires used as a single wire is properly called a "stranded wire." A wire or stranded wire covered with insulation is properly called an "insulated wire" or a "single-conductor cable." Nevertheless, when the context indicates that the wire is insulated, the term "wire" will be understood to include the insulation.

1.3 SUMMARY

- A. Where a panel is installed, at least 25% of panel capacity, accounting for serving panel capacity, shall remain as spare capacity after project completion.
- B. Where existing panels are used for additional work, when six (6) or less spaces remain a new panel shall be installed.

- C. All electrical/electronic circuits, including audio, video, and fire alarm systems, shall be in an approved raceway system. No "wild circuits" will be accepted.
- D. The Designer of Record shall not design or specify and the Contractor shall not install rigid metal conduit, electrical metallic tubing, flexible steel conduit, liquid-tight flexible steel conduit, non-metallic rigid conduit or innerduct in any horizontal or vertical concrete wall or slab structures or portions thereof, e.g., cast-in-place concrete floor slab on steel decking; cast-in-place concrete slabs integral with concrete structural support systems; prestressed concrete slabs; post-tensioned concrete slabs; precast concrete construction with or without field applied or plant fabricated concrete topping slabs, slabs on grade, foundation walls or in concrete cast-in-place walls, etc.
- E. Excessive use of wire nuts is prohibited. All efforts must be made to install electrical circuits continuous and in a neat arrangement.

1.4 COORDINATION

- A. Prior to fabrication or installation of any electrical work, participate in detailed coordination planning meetings with all other building utilities system trades, under the direction of the General Contractor, so as to completely establish routings, elevations, space requirements, and coordination of access, layout, and suspension requirements in relationship to the building structure and the work of all other trades.
- B. Any electrical work penetrating concrete walls or floors shall require saw cutting and/or core drilling and shall require approval by the GJT Project Manager. The Contractor shall perform all necessary imaging (x-rays, etc.) as specified, and submit shop drawings of any saw cutting or core drilling to the GJT Project Manager prior to performing the Work. Refer to Section 017330 "Cutting and Patching" for additional requirements.
- C. Any power outages necessary to install or test electrical systems and/or equipment shall be coordinated with GJT Airport Maintenance/Engineering. A written shutdown request form shall be submitted to and approved by the GJT Project Manager two (2) weeks prior to the shutdown.
- D. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:
 - 1. Notify Construction Manager and Owner no fewer than 10 Business days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Construction Manager's and Owner's written permission.
 - 3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:
 - a. Exercising generators.
 - b. Emergency lighting.
 - c. Elevators.

- d. Fire-alarm systems.
- E. Arrange to provide temporary electrical service or power in accordance with requirements specified in Division 01.

1.5 COORDINATION DRAWINGS

- A. Where the Contractor modifies the design, through selection of equipment differing from that shown, coordination drawings shall be provided by the Contractor in accordance with Division 1 to a scale of 1/4"=1'0" or larger for equipment rooms, details, congested areas and sections; other plans at a scale of 1/8"=1'0". These drawings are to detail major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components.
- B. Coordination drawings shall be in accordance with current GJT standards for format, and as outlined in Division 1.
- C. The Contractor shall indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
 - 1. Indicate the proposed locations of raceway systems, equipment, and materials. Include the following:
 - a. Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.
 - b. Exterior wall and foundation penetrations.
 - c. Fire-rated wall and floor penetrations.
 - d. Equipment connections and support details.
 - e. Sizes and location of required concrete pads and bases.
 - f. Support details.
 - 2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
 - 3. Floor plans, elevations, and appropriate details are required to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

1.6 ENVIRONMENTAL CONDITIONS

- A. The equipment shall be designed and constructed to operate successfully at the rated values under the following environmental conditions:
 - 1. Altitude: 5,500 feet above sea level.
 - 2. Ambient Temperature Range: Minus 30 deg F to 104 deg F.
 - 3. Wind Load: 120 mph with gust factor of 1.3.
 - 4. Relative humidity: 95% non-condensing.

1.7 PREINSTALLATION MEETINGS

- A. Electrical Preconstruction Conference: Schedule conference with Architect and Owner, not later than 10 days after notice to proceed. Agenda topics include, but are not limited to, the following:
 - 1. Electrical installation schedule.
 - 2. Status of power system studies.
 - 3. Value analysis proposals and requests for substitution of electrical equipment.
 - 4. Utility work coordination and class of service requests.
 - 5. Commissioning activities.
 - 6. Sustainability activities, including Measurement and Verification Plan.

1.8 SEQUENCING

- A. Conduct and submit results of power system studies before submitting Product Data and Shop Drawings for electrical equipment.

1.9 SCHEDULING

- A. Notify Construction Manager and Owner no fewer than 10 days in advance of unusual scheduling coordination.

1.10 ACTION SUBMITTALS

- A. Coordination drawings.

1.11 INFORMATIONAL SUBMITTALS

- A. Electrical installation schedule.

- B. Qualification statements.
- C. Welding certificates.
- D. Seismic-load performance certificates and wind-load performance certificates.
- E. Delegated design drawings for structural masonry wall penetrations.

1.12 TESTING, ACCEPTANCES AND CERTIFICATIONS SUBMITTALS

- A. Power cable high potential test reports:
 - 1. Insulation resistance tests.
 - 2. Continuity tests.
- B. Transformer test reports to include where applicable:
 - 1. Transformer turns ratio.
 - 2. Winding resistance.
 - 3. Insulation power factor.
 - 4. K Factor.
- C. All electrical/electronic equipment and systems functional test report.
- D. All other reports required by individual specification sections.
- E. Generator load bank test report.
- F. transfer Switch test report.
- G. Load balance report for each switch board, panel board and switch gear.

1.13 CLOSEOUT SUBMITTALS

- A. Facility EPM program binders.
- B. Operation and maintenance data.
- C. Software and firmware operational documentation.
- D. Software.

1.14 QUALITY ASSURANCE

- A. Qualifications: Prepare and submit qualification statements for the following entities performing Work on Project:
1. Qualified Regional Manufacturer: Manufacturer, possessing qualifications specified in Section 014000 "Quality Requirements," that maintains a service center capable of providing training, parts, and emergency on-site repairs to Project site with response time less than eight hours.
 2. Electrical Professional Engineer: Professional engineer possessing active qualifications specified in Section 014000 "Quality Requirements," with expertise in electrical engineering, including electrical power system modeling and analysis of electrical safety in accordance with NFPA 70E.
 3. EPM Specialist: Recognized experts possessing the following qualifications in accordance with Section 014000 "Quality Requirements" and NFPA 70B:
 - a. Technical Competence: Person should, by education, training, and experience, be well-rounded in all aspects of electrical maintenance.
 - b. Administrative and Supervisory Skills: Person should be skilled in planning and development of long-range objectives to achieve specific results and should be able to command respect and solicit cooperation of persons involved in EPM Program development.
 4. Welder: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," with training and certification in accordance with AWS D1.1/D1.1M.
 5. ERM-C-S-PVC Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by ERM-C-S-PVC manufacturer prior to starting installation.
 6. Power Quality Specialist: Recognized experts possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction, and able to present unexpired NICET Level 4 credentials with documented experience in power quality testing for installations similar in complexity to this Project.
 7. Low-Voltage Electrical Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
 - a. On-site electrical testing supervisors must have documented certification and experience with testing electrical equipment in accordance with NETA testing standards.
 8. Structural Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training

and experience with testing structural concrete, seismic controls, and wind-load controls.

9. Luminaire Photometric Testing Laboratory: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" accredited under the NVLAP for Energy Efficient Lighting Products, and complying with applicable IES testing standards.
10. Lighting Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with testing and inspecting lighting installations in accordance with IES LM-5.

B. Certifications:

1. Seismic-Load Performance Certificates: Provide special certification for designated seismic systems as indicated in Paragraph 13.2.2 "Special Certification Requirements for Designated Seismic Systems" of ASCE/SEI 7-05 for all designated seismic-load systems identified on Drawings or in the Specifications.
 - a. Include the following information:
 - 1) Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2) Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3) Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - 4) Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
 - 5) Provide equipment manufacturer's written certification for each designated active electrical seismic device and system, stating that it will remain operable following the design earthquake. Certification must be based on requirements of ASCE/SEI 7, including shake table testing per ICC-ES AC156 or a similar nationally recognized testing standard procedure acceptable to authorities having jurisdiction, or experience data as permitted by ASCE/SEI 7-05.
 - 6) Provide equipment manufacturer's written certification that components with hazardous contents maintain containment following the design earthquake by methods required in ASCE/SEI 7-05.
 - 7) Submit evidence demonstrating compliance with these requirements for approval to authorities having jurisdiction after review and acceptance by qualified structural professional engineer.
 - b. The following systems and components are Designated Seismic Systems and require written special certification of seismic qualification by manufacturer:
 - 1) Hangers and supports specified in Section 260529 "Hangers and Supports for Electrical Systems."
 - 2) Conduits and their mounting provisions specified in Section 260533.13 "Conduits for Electrical Systems."
 - 3) Boxes and their mounting provisions specified in Section 260533.16 "Boxes and Covers for Electrical Systems."

- 4) Surface raceways and their mounting provisions specified in Section 260533.23 "Surface Raceways for Electrical Systems."
- 5) Seismic restraints specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- 6) Equipment, accessories, and components specified in Section 262416 "Panelboards."
- 7) Cabinets, enclosures, racks, and their mounting provisions specified in Section 262716 "Electrical Cabinets and Enclosures."
- 8) Equipment, accessories, and components specified in Section 262816 "Enclosed Switches and Circuit Breakers."
- 9) Equipment, accessories, and components specified in Section 263533 "Power Factor Correction Equipment."
- 10) Luminaires, accessories, and components specified in Section 265000 "Lighting."

1.15 FIELD CONDITIONS

- A. Modeling, analysis, product selection, installation, and quality control for Work specified in Division 26 must comply with requirements specified in Section 260011 "Facility Performance Requirements for Electrical."
- B. Service Conditions for Electrical Power Equipment: Besides conditions specified in Section 260011 "Facility Performance Requirements for Electrical," specified electrical power equipment must be suitable for operation under service conditions specified as usual service conditions in applicable NEMA PB series, IEEE C37 series, and IEEE C57 series standards
 - a. Exposure to significant solar radiation.
 - b. Exposure to fumes, vapors, or dust.
 - c. Exposure to explosive environments.
 - d. Ambient temperature not exceeding 122 deg F (50 deg C).
 - e. Exposure to hot and humid climate or to excessive moisture, including steam, salt spray, and dripping water.
 - f. Unusual transportation or storage conditions.
 - g. Unusual grounding resistance conditions.
 - h. Unusual space limitations.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. The electrical and mechanical equipment shall be completely tested in the field in the presence of GJT Inspectors in accordance with good and accepted industry engineering practices to assure that:

1. The equipment has not been damaged during manufacturing, shipping, or installation.
2. The equipment has been installed according to the requirements Contract Documents.
3. The equipment meets the requirements of the Contract Documents.

2.2 CONDUCTOR INSULATION TEST

- A. Prior to energizing, all building service cables feeders to and/or from transformers, switchboards, panel boards are to be tested with a 1000-volt insulation megohm meter to determine insulation resistance levels. Test cables rated for three hundred volt with a 500-volt megohm meter or as recommended by the manufacturer. All field test data is to be recorded, corrected to a baseline temperature, and furnished to the GJT Project Manager. A test is to include meggering between conductors and between each conductor and ground. Cables are to be meggered after installation with cables disconnected at both ends. Insulation test values shall meet or exceed the values given below:

Conductor Size (AWG or KCMIL)	Resistance (Megaohms - 1,000 ft.)
12-8	200
6-2/0	100
3/0-750	100

2.3 EXISTING EQUIPMENT TESTING

- A. Existing equipment impacted by the project shall be evaluated and tested in the field in the presence of GJT inspectors to ensure that:
1. The equipment is in good working order.
 2. The equipment has not been damaged during construction.
 3. The equipment as installed meets current code requirements where updates are required due to work in the area.

2.4 SUBSTITUTION LIMITATIONS FOR ELECTRICAL EQUIPMENT

- A. Substitution requests for electrical equipment will be entertained under the following conditions:
1. Notification of Contractor's intent to request substitutions for convenience must be declared during the Electrical Preconstruction Conference so potential risks to system performance and construction schedule may be identified for Contractor's response in submission of the substitution request. Submission of requests for substitutions for convenience must meet the conditions and deadline specified in Section 012500 "Substitution Procedures" to receive approval.

2. For electrical equipment and systems, substitutions for cause are considered major construction risks. If it is possible that Contractor may need to request substitutions for cause because of equipment unavailability, or inability to meet construction schedule because of lead time, Contractor must declare the possibility during the Electrical Preconstruction Conference to permit establishing a mitigation plan for minimizing risks to system performance and construction schedule.

PART 3 - EXECUTION

3.1 GENERAL

- A. If the Contractor finds during the testing that any piece of equipment failed to satisfactorily pass the required field test, the GJT Project Manager shall be promptly notified and the Contractor shall take the necessary actions for the prompt repair or replacement.

3.2 TESTING

- A. The Contractor shall allow only certified personnel to perform the testing.
- B. The Contractor shall perform the testing using all necessary safety precautions and proper test equipment.
- C. The Contractor shall notify the GJT Project Manager three (3) days in advance of the proposed testing dates.
- D. Witness of testing by GJT Inspector, Electrical Maintenance and Electrical Inspector.

3.3 PROCEDURES

- A. No area; new, remodeled, or existing shall be without a fully operational electrical system, except for scheduled outages.
- B. The contractor shall remove, relocate, or replace any electrical equipment or systems as required for installation of any structural, mechanical, or plumbing equipment.
- C. Maintain all existing electrical, control, communication, and signaling systems to the extent required by the owner.
- D. Where remodel or demolition interferes with circuits outside of the work area, schedule outages to rework the circuits as required.

- E. All items, including but not limited to equipment, devices, circuits, and conduits, that are removed and not designated by the Project Manager to be used or turned over to the owner shall be removed from the airport.

3.4 EXAMINATION

- A. Verification of Conditions
- B. Preinstallation Testing
- C. Evaluation and Assessment

3.5 PREPARATION

- A. Electrical Installation Schedule: At preconstruction meeting, and periodically thereafter as dates change, provide schedule for electrical installation Work to Owner and Architect including, but not limited to, milestone dates for the following activities:
 - 1. Submission of power system studies.
 - 2. Submission of specified coordination drawings.
 - 3. Submission of action submittals specified in Division 26.
 - 4. Orders placed for major electrical equipment.
 - 5. Arrival of major electrical equipment on-site.
 - 6. Preinstallation meetings specified in Division 26.
 - 7. Utility service outages.
 - 8. Utility service inspection and activation.
 - 9. Mockup reviews.
 - 10. Closing of walls and ceilings containing electrical Work.
 - 11. System startup, testing, and commissioning activities for major electrical equipment.
 - 12. System startup, testing, and commissioning activities for emergency lighting.
 - 13. System startup, testing, and commissioning activities for automation systems (SCADA, BMS, lighting, HVAC, fire alarm, fire pump, etc.).
 - 14. Pouring of concrete housekeeping pads for electrical equipment and testing of concrete samples.
 - 15. Requests for special inspections.
 - 16. Requests for inspections by authorities having jurisdiction.
- B. Coordination Drawings for Structural Supports: Show coordination of structural supports for equipment and devices, including restraints and bracing for control of seismic and wind loads, with other systems, equipment, and structural supports in the vicinity.
- C. Coordination Drawings for Ceiling Areas: Where indicated on Drawings, provide reflected ceiling plan(s), supplemented by sections and other details, drawn to scale, in accordance with Section 013100 "Project Management and Coordination," on which

the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which equipment, luminaires, and suspension systems will be attached.
3. Partitions and millwork that penetrate ceiling or extend to within **12 inch (300 mm)** of plane of luminaires.
4. Size and location of access panels on ceilings.
5. Elevation, size, and route of sprinkler piping.
6. Elevation, size, and route of plumbing piping.
7. Elevation, size, and route of ductwork.
8. Elevation, size, and route of cable tray.
9. Elevation, size, and route of conduit.
10. Elevation and size of wall-mounted and ceiling-mounted equipment.
11. Moldings.
12. Access panels.
13. Sprinklers.
14. Air inlets and outlets.
15. Control modules.
16. Luminaires.
17. Communications devices.
18. Speakers.
19. Ceiling-mounted projectors.
20. Security devices.
21. Fire-alarm devices.
22. Indicate clear dimensions for maintenance access in front of equipment.
23. Indicate dimensions of fully-open access doors.

- D. Coordination Drawings for Cable Tray Routing: Reflected ceiling plan(s), supplemented by sections and other details, drawn to scale, in accordance with Section 013100 "Project Management and Coordination," on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Elevation, size, and route of cable trays.
2. Relationships between components and adjacent structural, electrical, and mechanical elements.
3. Vertical and horizontal offsets and transitions.
4. Elevation and size of sleeves for wall, ceiling, and floor cable penetrations.
5. Elevation of ceilings and size of ceiling tiles.
6. Locations of access panels on ceilings.
7. Locations where cable tray crosses or parallels sprinkler piping.
8. Locations where cable tray crosses plumbing piping.
9. Locations where cable tray crosses or parallels ductwork.
10. Locations of access panels on ductwork.
11. Locations where cable tray crosses conduit.
12. Items blocking access around cable trays, including the following:

- a. Light fixtures.

- b. Speakers.
 - c. Fire-alarm devices.
 - d. Power outlets.
 - e. Wall-mounted equipment.
 - f. Equipment racks.
 - g. Furniture.
 - h. Door swings.
 - i. Building features.
- 13. Indicate clear dimension between cable tray and walls or obstructions that are closer than **10 ft (3 m)**.
- 14. Highlight locations where cable tray is greater than **3 ft (1 m)** above ceilings. Explain how personnel access will be accommodated for cable tray maintenance.
- E. Coordination Drawings for Conduit Routing: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- F. Coordination Drawings for Large Equipment Indoor Installations:
 - 1. Location plan, drawn to scale, showing heavy equipment or truck access paths to loading dock or other freight access into building. Indicate available width and height of doors or openings.
 - 2. Floor plan for entry floor and floor where equipment is located, drawn to scale, showing heavy equipment access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:
 - a. Dimensioned concrete bases, outlines of equipment, conduit entries, and grounding equipment locations.
 - b. If freight elevator must be used, indicate width and height of door and depth of car. Indicate if large equipment must be tipped to use elevator.
 - c. Dimensioned working clearances and dedicated areas below and around electrical equipment where obstructions and tripping hazards are prohibited.
 - 3. Reflected ceiling plans for entry floor and floor where equipment is located, drawn to scale, on which the following items shown and coordinated with each other, based on input from installers of the items involved:
 - a. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways.
 - b. Location of lighting fixtures, sprinkler piping and sprinklers, ducts and diffusers, and other obstructions, indicating available overhead clearance.

- c. Dimensioned working clearances and dedicated areas above and around electrical equipment where foreign systems and equipment are prohibited.

G. Coordination Drawings for Large Equipment Outdoor Installations:

- 1. Utilities site plan, drawn to scale, showing heavy equipment or truck access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:
 - a. Fences and walls, dimensioned concrete bases, outlines of equipment, conduit entries, and grounding and bonding locations.
 - b. Indicate clear dimensions for fence gates and wall openings.
 - c. Indicate depth and type of ground cover, and locations of trees, shrubbery, and other obstructions in access path.
 - d. Indicate clear height below tree branches, overhead lines, bridges, and other overhead obstructions in access path, or where cranes and hoists will be needed to handle large electrical equipment.
 - e. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways.
 - f. Dimensioned working clearances and dedicated areas around electrical equipment.

H. Protection of In-Place Conditions

3.6 DELEGATED DESIGN OF STRUCTURAL PENETRATIONS

- A. Engage qualified structural professional engineer to design penetrations of structural masonry walls.
- B. Delegated Design Drawings for Structural Masonry Wall Penetrations: Where indicated on Drawings, provide reflected ceiling plan(s), supplemented by elevations, sections, and other details, drawn to scale, signed and sealed by a qualified structural professional engineer, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Location and dimensions of structural members supporting wall.
 - 2. Location and dimensions of columns near penetrations.
 - 3. Location and dimension of headers and lintels.
 - 4. Doors and windows near penetrations.
 - 5. Location and dimensions of penetrating cuts.
 - 6. Sprinkler piping and sleeves.
 - 7. Plumbing piping and sleeves.
 - 8. Ductwork and sleeves.
 - 9. Cable tray and sleeves.
 - 10. Conduit and sleeves.
 - 11. Firestopping assemblies for rated penetrations.
 - 12. Structural supports for piping, ductwork, and conduit on both sides of wall.

- C. Delegated Design Criteria: As depicted on Drawings.

3.7 INSTALLATION OF ELECTRICAL WORK

- A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Architect for resolution of conflicting requirements.

3.8 SYSTEM STARTUP

- A. Commissioning Activities
 - 1. Commissioning Requirements, but not limited to:
 - a. Lighting Systems
 - b. Lighting Control Systems

3.9 FIELD QUALITY CONTROL

- A. Adminstrant for Low-Voltage Electrical Tests and Inspections:
 - 1. Owner will engage qualified low-voltage electrical testing and inspecting agency to administer and perform tests and inspections.
 - 2. Engage qualified low-voltage electrical testing and inspecting agency to administer and perform tests and inspections.
 - 3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
 - 4. Administer and perform tests and inspections.
- B. Adminstrant for Field Tests and Inspections of Lighting Installations:
 - 1. Owner will engage qualified lighting testing and inspecting agency to administer and perform tests and inspections.
 - 2. Engage qualified lighting testing and inspecting agency to administer and perform tests and inspections.
 - 3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
 - 4. Administer and perform tests and inspections.

3.10 CLEANING

- A. Waste Management – Coordinate with Owner's Representative.

3.11 CLOSEOUT ACTIVITIES

A. Development of Facility EPM Program

1. Facility EPM Program must be developed by qualified EPM specialist.
2. Conduct Facility EPM Program analysis in accordance with NFPA 70B recommendations.
 - a. Renovation Projects:
 - 1) Facility diagrams must include connected existing equipment for entire facility where known. Areas of uncertainty should be clearly indicated.
 - 2) Obtain copies of existing operation and maintenance data and existing Facility EPM Program information from Owner.
 - 3) Facility EPM Program analysis should identify existing equipment that does not have available operation and maintenance data, and should explain the Owner's risks because this equipment is not included in Facility EPM Program.
 - 4) Data for existing equipment outside scope of Project may be inserted in Facility EPM Program Binders without analysis.
 - 5) Data for existing equipment impacted by scope of Project should be analyzed and documented similar to Project's new equipment data as much as possible.
3. Compile operation and maintenance data from Facility EPM Program analysis and submit Facility EPM Program Binders.
4. Organization of Facility EPM Program Binders:
 - a. Description: Set of binders containing operation and maintenance data for facility's electrical equipment that was compiled during analysis of installed electrical Work for Facility EPM Program development.
 - b. Referenced Standards: Content must comply with recommendations in NFPA 70B.
 - c. General Characteristics:
 - 1) Volume 1 - Introduction:
 - a) Summarize how Facility EPM Program Analysis was performed, how data were collected, and how volumes are organized.
 - b) Describe Facility EPM Program and provide recommended policies and procedures for implementing the program and keeping it current.
 - c) Provide place for Owner to identify contact information for employees responsible for implementing and maintaining Facility EPM Program.

- 2) Volume 2 - Facility Safety, Hazards Awareness, and Emergency Procedures:
 - a) Include training requirements for employees and contractors.
 - b) Include list of known facility hazards impacting IT&R activities.
 - c) Include approval and permitting procedures for IT&R activities.
 - d) Include incident emergency response procedures.
 - e) Include emergency shutdown procedures.
 - f) Include electrical disaster recovery procedures.
- 3) Volume 3 - Operating Procedures for Electrical Equipment and Controls:
 - a) Include copies of demonstration and training videos.
- 4) Volume 4 - Facility Diagrams and Schedules:
 - a) Include single-line diagrams.
 - b) Include grounding and bonding diagrams.
 - c) Include essential wiring diagrams.
 - d) Include system communications diagrams (WAN, LAN, Wi-Fi, ERCES, MNS, etc.)
 - e) Include system automation diagrams (SCADA, BMS, lighting, HVAC, etc.).
 - f) Include records of switchgear, switchboard, and panelboard schedules.
 - g) Include time-current curves for overcurrent protective devices.
 - h) Include list of load-current and overload-relay heaters with related motor nameplate data.
- 5) Volume 5 - Inventory of Facility Equipment Using Electrical Power:
 - a) Include simplified floor plans showing equipment locations.
 - b) Identify critical equipment (electrical or otherwise).
 - c) Include identifying designations and nameplate data.
 - d) Include warranty and maintenance contract information.
- 6) Volume 6 - Inventory of Facility Tools, Supplies, and Personnel Protective Equipment:
 - a) Include schedules of maintenance material items recommended to be stored at facility.
 - b) Include list of lamp types and photoelectric relays used in facility with ANSI and manufacturers' codes.
 - c) Include calibration and servicing data for each item.
- 7) Volume 7 - Inspection, Testing, and Repair (IT&R) Plan:
 - a) Include tables showing frequency of activities for each item.

- b) Include annual schedule with activities mapped to specific days of the year.
 - c) Include exterior pole inspection and repair procedures.
 - 8) Volume 8 - Spare Parts List:
 - a) Include list of all parts required to perform IT&R procedures.
 - b) Identify quantities of which parts are recommended to be stored on-site.
 - c) Include source contact information and budget cost for each item.
 - 9) Volume 9 - Construction Project Closeout Record Documentation:
 - a) Include records of power system studies and photometric studies.
 - b) Include records of risk assessment studies.
 - c) Include records of electrical system startup and commissioning activities.
 - d) Include records of baseline inspections and tests.
 - e) Include records of baseline infrared photographs with normal light photographs showing the location, direction, angle, and conditions necessary for reproducing each infrared photograph.
 - f) Include records of baseline settings for adjustable equipment and devices.
- 5. Format of Facility EPM Program Binders Submittal:
 - a. Complete Set: On approved online or cloud solution and USB media that is clearly and permanently labeled with attached placard on lanyard to prevent misplacement.
 - b. Volumes 2 and 8: Reproducible hardcopy on archival quality, **28 lb (105 GSM)**, acid-free, bond paper.
- B. Operation and Maintenance Data: Prepare and submit the following:
 - 1. Provide emergency operation, normal operation, and preventive maintenance manuals for each system, equipment, and device listed below:
 - a. Panelboards
 - b. Luminaires
 - c. Lighting Control Systems
 - d. Fire Alarm
 - e. Security
 - f. UPS Systems
 - 2. Include the following information:
 - a. Manufacturer's operating specifications.

- b. User's guides for software and hardware.
 - c. Schedule of maintenance material items recommended to be stored at Project site.
 - d. Detailed instructions covering operation under both normal and abnormal conditions.
 - e. Time-current curves for overcurrent protective devices and manufacturer's written instructions for testing and adjusting their settings.
 - f. List of load-current and overload-relay heaters with related motor nameplate data.
 - g. List of lamp types and photoelectric relays used on Project, with ANSI and manufacturers' codes.
 - h. Manufacturer's instructions for setting field-adjustable components.
 - i. Manufacturer's instructions for testing, adjusting, and reprogramming microprocessor controls.
 - j. EPSS: Manufacturer's system checklists, maintenance schedule, and maintenance log sheets in accordance with NFPA 110.
 - k. Exterior pole inspection and repair procedures.
 - l. Include copies of demonstration and training videos.
- C. Software and Firmware Operational Documentation: Provide software and firmware operational documentation in Facility EPM Program Binders, including the following:
- 1. Software operating and upgrade manuals.
 - 2. Names, versions, and website addresses for locations of installed software.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.
 - 5. Testing and adjusting of panic and emergency power features.
 - 6. For lighting controls, include the following:
 - a. Adjustments of scene preset controls, adjustable fade rates, and fade overrides.
 - b. Operation of adjustable zone controls.
- D. Software:
- 1. Program Software Backup: Provide username and password for approved online or cloud solution and USB media that is clearly and permanently labeled with attached placard on lanyard to prevent misplacement.
 - 2. Provide to Owner upgrades and unrestricted licenses for Government use for installed and backup software, including operating systems and programming tools required for operation and maintenance.
- E. Demonstration: With assistance from factory-authorized service representatives, demonstrate to Owner's maintenance and clerical personnel how to operate the following systems and equipment:
- 1. Lighting control devices specified in Section 260923 "Lighting Control Devices."
- F. Training: Train Owner's maintenance personnel on the following topics:

1. How to implement Facility EPM Program.
2. How to operate normal and emergency electrical systems, including justifications for, and limitations of, protective device settings recommended in study report specified in Section 260573.16 "Coordination Studies."
3. Electrical power safety fundamentals refresher including arc-flash hazard safety features of electrical power distribution equipment in facility, interpreting arc-flash warning labels, selecting appropriate personal protective equipment, and understanding significance of findings documented in study report specified in Section 260573.19 "Arc-Flash Hazard Analysis."
4. How to adjust, operate, and maintain devices specified in Section 260923 "Lighting Control Devices."
5. How to adjust, operate, and maintain control modules specified in Section 262416 "Panelboards."
6. How to adjust, operate, and maintain equipment specified in Section 265213 "Emergency and Exit Lighting."
7. How to adjust, operate, and maintain equipment specified in Section 263533 "Power Factor Correction Equipment."

END OF SECTION 260010

SECTION 260011 - FACILITY PERFORMANCE REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Field conditions and other facility performance requirements applicable to Work specified in Division 26.

1.2 FIELD CONDITIONS

A. Seismic Hazard Design Loads:

1. Unless otherwise indicated on Contract Documents, specified Work must withstand seismic hazard design loads determined in accordance with requirements specified in this Section, adjusted for installed elevation above or below grade.
 - a. The term "withstand" means "unit must remain in place without separation of parts from unit when subjected to specified seismic hazard design loads."
2. Perform calculations to obtain force information necessary to properly select seismic-restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in ASCE/SEI 7-05. Where "ASCE/SEI 7" is used throughout this Section, it must be understood that the edition referred to in this subparagraph is the edition intended as reference throughout the Section Text.
 - a. Data indicated below to be determined by Delegated Design Contractor must be obtained by Contractor and must be included in individual component submittal packages.
 - b. Coordinate seismic design calculations with wind-load calculations for equipment mounted outdoors.

B. Wind Hazard Design Loads:

1. Perform calculations to obtain force information necessary to properly select wind-load restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in ASCE/SEI 7-05. Where "ASCE/SEI 7" is used throughout this Section, it must be understood that the edition referred to in this subparagraph is intended as referenced throughout the Section Text unless otherwise indicated.

- a. Data indicated below that are specific to individual pieces of equipment must be obtained by Contractor and must be included in individual component submittal packages.
 - b. Coordinate design wind-load calculations with seismic-load calculations for equipment requiring both seismic- and wind-load reinforcement. Comply with requirements in other Sections in addition to those in this Section.
2. Design wind pressure "p" for external sidewall-mounted equipment must be calculated by Delegated Design Contractor using methods in ASCE/SEI 7-16, Ch. 30. Perform calculations according to one of the following, as appropriate:
 - a. PART 1: Low-Rise Buildings.
 - b. PART 2: Low-Rise Buildings (Simplified).
 - c. PART 3: Buildings with "h" less than 60 ft. (18.3 m).
 - d. PART 4: Buildings with "h" greater than 60 ft. (18.3 m) and less than 160 ft. (48.8 m).
 - e. PART 5: Open Buildings.
- C. Altitude:
 1. Sea level to 1000 ft. (300 m).
- D. Ambient Temperature:
 1. 73 degrees F.
- E. Temperature Variation: Allow for thermal movements from the following differential temperatures:
 1. Ambient Temperature Differential: 120 deg F (67 deg C).
 2. Material Surface Temperature Differential: 180 deg F (100 deg C).
 3. Ground Surface Temperature Differential to 10 ft. (3 m) Depth: .
- F. Ground Water:
 1. Assume ground-water level is at grade level unless a lower water table is noted on Drawings.
 2. Assume ground-water level is 36 inch (900 mm) below ground surface unless a higher water table is indicated on Drawings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 260011

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 DEFINITIONS:

- A. Concessions tenant - A retail establishment, not an airline, that leases space at the airport.

1.2 SUMMARY

- A. Section Includes:

- 1. Copper building wire.
 - 2. Metal-clad cable, Type MC.
 - 3. Fire-alarm wire and cable.
 - 4. Connectors and splices.

- B. Related Requirements:

- 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
 - 3. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.

1.3 ACTION SUBMITTALS

- A. Product Data:

- 1. Copper building wire.
 - 2. Metal-clad cable, Type MC.
 - 3. Fire-alarm wire and cable.
 - 4. Connectors and splices.

- B. Product Schedule: Indicate type, use, location, and termination locations.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. All conductors shall be copper.
- B. AC cable and Modular wiring are not permitted.
- C. MC Cable: Comply with NEMA WC 70. Provide internal equipment grounding conductor throughout. Can only be used as noted in EXECUTION section of this specification.
- D. Remote Control and Signal Cable
 - 1. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600 volt insulation, rated at 60 deg C, individual conductors twisted together, shielded, and covered with a PVC jacket.
 - 2. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.

2.2 COPPER BUILDING WIRE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alpha Wire; brand of Belden, Inc.
 - 2. Belden Inc.
 - 3. Cerro Wire LLC.
 - 4. Encore Wire Corporation.
 - 5. General Cable; Prysmian Group North America.
 - 6. Okonite Company (The).
 - 7. Southwire Company, LLC.
 - 8. WESCO.
- B. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- E. Conductor Insulation:
 - 1. Type NM. Comply with UL 83 and UL 719.
 - 2. Type USE-2 and Type SE. Comply with UL 854.
 - 3. Type THHN and Type THWN-2. Comply with UL 83.
 - 4. Type UF. Comply with UL 83 and UL 493.
 - 5. Type XHHW-2. Comply with UL 44.

2.3 METAL-CLAD CABLE, TYPE MC

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alpha Wire; brand of Belden, Inc.
 - 2. Belden Inc.
 - 3. Cerro Wire LLC.
 - 4. Encore Wire Corporation.
 - 5. Okonite Company (The).
 - 6. Southwire Company, LLC.
 - 7. WESCO.
- B. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. Comply with UL 1569.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Circuits:
 - 1. Single circuit.
 - 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- F. Ground Conductor: Bare.
- G. Conductor Insulation:

1. Type TFN/THHN/THWN-2. Comply with UL 83.
2. Type XHHW-2. Comply with UL 44.

H. Armor: Steel, interlocked.

I. Jacket: PVC applied over armor.

2.4 FIRE-ALARM WIRE AND CABLE

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

1. Allied Wire & Cable Inc.
2. CommScope, Inc.
3. Comtran Corporation.
4. Genesis; Resideo Technologies, Inc.
5. PYROTENAX; brand of nVent Electrical plc.
6. Prysmian Cables and Systems; Prysmian Group North America.
7. Radix Wire.
8. Rockbestos-Suprenant Cable Corp.
9. Superior Essex Inc.; subsidiary of LS Corp.
10. West Penn Wire; brand of Belden, Inc.

B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 16 AWG.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600 V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.

2.5 CONNECTORS AND SPLICES

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

1. 3M Electrical Products.
2. ABB, Electrification Business.
3. AFC Cable Systems; Atkore International.
4. Gardner Bender.

5. Hubbell Utility Solutions; Hubbell Incorporated.
 6. ILSCO.
 7. Ideal Industries, Inc.
 8. NSi Industries LLC.
 9. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 10. Service Wire Co.
 11. TE Connectivity Ltd.
 12. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- B. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
1. Material: Copper
 2. Type: Two hole with long barrels.
 3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger, except for connection to vibrating equipment then stranded shall be used.
- C. Prohibited Cable Types: UF, NM, SE, AC.
- D. ASD Output Circuits Cable: Extra-flexible stranded for all sizes.
- E. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.
- D. Feeders below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- E. Feeders Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.
- F. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- I. Branch Circuits Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.
- J. Branch Circuits in Cable Tray: Type THHN-THWN, single conductors in raceway.
- K. Class 1 Remote Control and Signal Circuits: Type THHN-THWN, in raceway or cable tray as applicable, or Copper conductor, 600 volt insulation, individual conductors twisted together, shielded, and covered with a PVC jacket.
- L. Class 2 Remote Control and Signal Circuits: Type THHN-THWN, in raceway or cable tray as applicable, or Copper conductor, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.
- M. All power, control, data, communication and signal wire or cable shall be installed in an approved raceway.
- N. MC Cable: Only allowed under the following conditions:
 - 1. Light fixture whips when prewired at the factory.
 - 2. Concession Tenant installations

No other uses of MC cable are allowed unless authorization is obtained in advance from GJT project manager. Cable shall be run concealed in all locations. Where circuiting must be exposed, provide single conductor building wire in approved raceway. MC cable shall be supported using approved methods throughout. Do not run cables unsupported in any area including above accessible ceilings, in unfinished area, etc.

3.3 INSTALLATION OF CONDUCTORS

- A. All power, control, data, communication, and signal wire or cable shall be installed in an approved raceway (raceway shall be defined as conduit or cable tray as applicable).
- B. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- C. Neatly train wiring inside boxes, equipment, and panel boards. Make temporary connections to panel board devices with sufficient slack conductor to facilitate reconnections required for balancing loads between phases.
- D. Conductors shall not be pulled in concrete encased conduits before concrete is placed.
 - 1. Conduits encased in concrete are not allowed unless prior authorization is received from GJT project manager.
- E. For connection to vibrating equipment, stranded wire shall be used.
- F. All conduits to be new. Existing conduits shall not be used unless approved by the GJT Project Manager.
- G. Where harmonic currents exist on feeders that supply panelboards that serve electronic equipment of 40 percent or more of the panelboards total ampacity, two (2) full size neutral conductors or a neutral conductor rated at 200 percent shall be provided to the panelboard being served. A neutral bus bar rated at 200 percent shall also be provided in the panelboard.
- H. Shared Neutrals: Prohibited. A full-size neutral conductor shall be provided for each single-phase circuit.

3.4 INSTALLATION OF FIRE-ALARM WIRE AND CABLE

- A. Comply with NFPA 72.
- B. Wiring Method: Install wiring in metal pathway according to Section 270528.29 "Hangers and Supports for Communications Systems."
 - 1. Install plenum cable in environmental airspaces, including plenum ceilings.
 - 2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system must be installed in a dedicated pathway system.
 - a. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
 - 3. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70, Types MI and CI, is not permitted.

4. Signaling Line Circuits: Power-limited fire-alarm cables must not be installed in the same cable or pathway as signaling line circuits.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.
- F. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.
- G. Wiring to Remote Alarm Transmitting Device: 1 inch (25 mm) conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 CONNECTIONS

- A. Splice only in accessible junction and outlet boxes.
- B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- C. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- D. Wiring at Outlets: Install conductor at each outlet, with at least 6 inch (150 mm) of slack.
- E. Comply with requirements in Section 284621.11 "Addressable Fire-Alarm Systems" for connecting, terminating, and identifying wires and cables.

3.6 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.8 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Field inspection and testing will be performed under provisions of Division 01.
 - 2. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.
 - a. Prior to energizing, all building service cables, feeders to and/or from transformers, switchboards and panel boards are to be tested with a 500-volt insulation megohm meter to determine insulation resistance levels. All field test data is to be recorded, corrected to a baseline temperature, and furnished to the GJT Project Manager. A test is to include meggering for one minute between conductors and between each conductor and ground. Cables are to be meggered after installation with cables disconnected at both ends. Insulation test values shall meet or exceed the values given below.

Conductor Size (AWG or KCMIL): Resistance (Megohms-1,000ft):

12-8	200
6-2/0	100

3/0-750

100

3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
 - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice eleven (11) months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
 4. Inspect wire and cable for physical damage and proper connection.
- B. Test and Inspection Reports: Prepare a written report to record the following:
1. Test procedures used.
 - a. Test results that comply with requirements.
 - b. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. 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: (Depending on location 50 or 450) or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.
2. Test optical fiber cable on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.
3. Test each pair of cable for open and short circuits.

1.3 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating

and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.4 SUMMARY

A. Section Includes:

1. Category 5e balanced twisted pair cable.
2. Category 6 balanced twisted pair cable.
3. Category 6a balanced twisted pair cable.
4. Control cable.
5. Control-circuit conductors.
6. Fire-alarm wire and cable.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.5 ACTION SUBMITTALS

A. Product Data:

1. Control cable.
2. Control-circuit conductors.
3. Fire-alarm wire and cable.

1.6 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. Support of Open Cabling: NRTL labeled for support of (Category 5e or Category 6 per design) cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.

2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

B. Cable Trays:

1. Cable Tray Materials: Metal, suitable for indoors and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch thick or hot-dip galvanizing, complying with ASTM A 123/A 123M, Grade 0.55, not less than 0.002165 inch thick.

C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.

1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.2 RS-485 BACNET MS/TP DATA TRANSMISSION CABLE

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

1. Southwire
2. Windy City Wire: WCW-22/3BLU-WC
3. Or approved equal

B. Description: UL Listed C(UL) US CMP or FPLP (UL).

1. Shielded, Plenum-rated
2. (3) 22AWG insulated conductors with 24AWG bare copper drain
3. Overall jacket color: Blue
4. Conductor colors: Black/White/Blue
5. Marking: "POWER METERING CONTROL SYSTEM"

2.3 PERFORMANCE REQUIREMENTS

- A.** Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B.** Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.

1. Flame Travel Distance: 60 inch (1520 mm) or less.
 2. Peak Optical Smoke Density: 0.5 or less.
 3. Average Optical Smoke Density: 0.15 or less.
- C. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
- D. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

2.4 CONTROL CABLE

- A. Paired Cable: NFPA 70, Type CMG.
1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
 2. PVC insulation.
 3. Unshielded.
 4. PVC jacket.
 5. Flame Resistance: Comply with UL 1685.
 6. Lead Content: Less than 300 parts per million.
- B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
 2. PVC insulation.
 3. Unshielded.
 4. PVC jacket.
 5. Flame Resistance: Comply with NFPA 262.
 6. Lead Content: Less than 300 parts per million.

2.5 CONTROL-CIRCUIT CONDUCTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Encore Wire Corporation.
 2. General Cable; Prysmian Group North America.
 3. Service Wire Co.
 4. Southwire Company, LLC.
- B. Class 1 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
- C. Class 2 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

- D. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

2.6 FIRE-ALARM WIRE AND CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Allied Wire & Cable Inc.
 - 2. CommScope, Inc.
 - 3. Comtran Corporation.
 - 4. Genesis; Resideo Technologies, Inc.
 - 5. Prysmian Cables and Systems; Prysmian Group North America.
 - 6. Radix Wire.
 - 7. Rockbestos-Suprenant Cable Corp.
 - 8. Superior Essex Inc.; subsidiary of LS Corp.
 - 9. West Penn Wire; brand of Belden, Inc.
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- C. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.
 - 1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.
- D. Non-Power-Limited Circuits: Solid-copper conductors with 600 V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
 - 1. Control-Voltage Circuits: No. 16 AWG, minimum, in pathway.
 - 2. Low-Voltage Circuits: No. 12 AWG, minimum, in pathway.
 - 3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with red identifier stripe, NRTL listed for fire-alarm and cable tray installation, plenum rated.

2.7 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test twisted pair cables according to TIA-568-C.2.
- C. Cable will be considered defective if it does not pass tests and inspections.

- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- C. Install manufactured conduit sweeps and long-radius elbows if possible.
- D. Pathway Installation in Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed or in the corner of room if multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard if entering room from overhead.
 - 4. Extend conduits 3 inches above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- E. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - 1. Multimode Link Measurements: Test at 850 or 1300 nm in one direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.

2. Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

3.3 EXAMINATION

- A. Test cables on receipt at Project site.
 1. Test each pair of twisted pair cable for open and short circuits.

3.4 INSTALLATION OF RACEWAYS AND BOXES

- A. Comply with requirements in Section 260533.13 "Conduits for Electrical Systems" for raceway selection and installation requirements for conduits as supplemented or modified in this Section.
- B. Comply with requirements in Section 260533.23 "Surface Raceways for Electrical Systems" for raceway selection and installation requirements for wireways as supplemented or modified in this Section.
- C. Comply with requirements in Section 260533.16 "Boxes and Covers for Electrical Systems" for raceway selection and installation requirements for boxes as supplemented or modified in this Section.
 1. Outlet boxes must be no smaller than 2 inch (50 mm) wide, 3 inch (75 mm) high, and 2-1/2 inch (64 mm) deep.
 2. Outlet boxes for cables must be no smaller than 4 inch (102 mm) square by 2-1/8 inch (53 mm) deep with extension ring sized to bring edge of ring to within 1/8 inch (3.1 mm) of the finished wall surface.
 3. Flexible metal conduit must not be used.
- D. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.
- E. Install manufactured conduit sweeps and long-radius elbows if possible.
- F. Raceway Installation in Equipment Rooms:
 1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
 2. Install cable trays to route cables if conduits cannot be located in these positions.
 3. Secure conduits to backboard if entering the room from overhead.
 4. Extend conduits 3 inch (75 mm) above finished floor.
 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

- G. Backboards: Install backboards with 96 inch (2440 mm) dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.5 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.

- B. General Requirements for Cabling:

1. Comply with TIA-568-C Series of standards.
2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
3. Terminate all conductors; cable must not contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced and must be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
6. Secure and support cables at intervals not exceeding 30 inch (760 mm) and not more than 6 inch (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
11. Support: Do not allow cables to lie on removable ceiling tiles.
12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
13. Provide strain relief.
14. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
15. Ground wire must be copper, and grounding methods must comply with IEEE C2. Demonstrate ground resistance.

- C. Balanced Twisted Pair Cable Installation:

1. Comply with TIA-568-C.2.
2. Install termination hardware as specified in Section 271513 "Communications Copper Horizontal Cabling" unless otherwise indicated.

3. Do not untwist balanced twisted pair cables more than 1/2 inch (12 mm) at the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:

1. Install wiring in raceways.
2. Use insulated spade lugs for wire and cable connection to screw terminals.

E. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment must be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inch (127 mm).
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inch (305 mm).
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inch (600 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment must be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inch (64 mm).
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inch (150 mm).
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inch (305 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures must be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inch (75 mm).
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inch (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inch (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inch (127 mm).

3.6 REMOVAL OF CONDUCTORS AND CABLES

- A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified with a tag for future use.

3.7 CONTROL-CIRCUIT CONDUCTORS

- A. Minimum Conductor Sizes:
 - 1. Class 1 remote-control and signal circuits; No 14 AWG.
 - 2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
 - 3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.8 FIRESTOPPING

- A. Comply with requirements in Section 079200 "Joint Sealants".
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.9 GROUNDING

- A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
- B. For control-voltage wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.10 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers must use label stocks, laminating adhesives, and inks complying with UL 969.
- C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire must have a unique tag.

3.11 FIELD QUALITY CONTROL

- A. Tests and Inspections:

1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.
 - a. Test instruments must meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- B. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- C. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 260523

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

- A. External (underground) metal pipers, water, gas, fuel, drain/sewer etc., are not available for electrical grounding. This is due to extensive cathodic protection and isolation joints of all underground metal pipes at GJT. These systems shall be bonded to the grounding system on the building side only.

1.2 SUMMARY

- A. Section Includes:

- 1. Grounding and bonding conductors.
 - 2. Grounding and bonding clamps.
 - 3. Grounding and bonding bushings.
 - 4. Grounding and bonding connectors.
 - 5. Grounding and bonding busbars.

- B. Related Requirements:

- 1. Section 260010 "Supplemental Requirements for Electrical" specifies additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 260011 "Facility Performance Requirements for Electrical" specifies seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:

- 1. In addition to items specified in Section 260010 "Supplemental Requirements for Electrical," include the following:

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. All ground wires shall be copper, sized according to the NEC or as shown on the drawings whichever is larger.
- B. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Codes.
- C. Bare Copper Conductors:
 - 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 3. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 4. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- D. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.2 CONNECTORS

- A. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions. Exothermic welded connections are required where grounding conductors connect to underground grounding conductors and to underground grounding electrodes, and for bonding to steel. All underground connections shall be exothermic welded.
- C. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Grounding Connection Accessories:

1. Electrical insulating tape, heat-shrinkable insulating tubing, welding materials, bonding straps, as recommended by accessories manufacturers for type of service required.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad; 3/4-inch diameter and a minimum length of 10 feet.
- B. Ground Rods in manholes: Stainless steel; 3/4-inch diameter and a minimum length of 10 feet.

2.4 GROUNDING AND BONDING CONDUCTORS

- A. Equipment Grounding Conductor:
 - 1. General Characteristics: 600 V, THHN/THWN-2, copper wire or cable, green color, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Isolated Equipment Grounding Conductor:
 - 1. General Characteristics: 600 V, THHN/THWN-2, copper wire or cable, green color with one or more yellow stripes, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. ASTM - Bare Copper Grounding and Bonding Conductor:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ERICO; brand of nVent Electrical plc.
 - b. Harger Lightning & Grounding; business of Harger, Inc.
 - 2. Referenced Standards: Complying with one or more of the following:
 - a. Soft or Annealed Copper Wire: ASTM B3.
 - b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
 - c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.
 - d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

2.5 GROUNDING AND BONDING CLAMPS

- A. Description: Clamps suitable for attachment of grounding and bonding conductors to grounding electrodes, pipes, tubing, and rebar. Grounding and bonding clamps specified in this article are also suitable for use with communications applications.

- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 - b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.
- D. UL KDER and KDSH - Hex-Fitting-Type Pipe and Rod Grounding and Bonding Clamp:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Cooper B-line; brand of Eaton, Electrical Sector.
 - c. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - d. ERICO; brand of nVent Electrical plc.
 - e. ILSCO.
 - f. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - g. Panduit Corp.
 - h. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - i. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 2. General Characteristics:
 - a. Two pieces with stainless steel bolts.
 - b. Clamp Material: Silicon bronze.
 - c. Listed for outdoor use.
- E. UL KDER and KDSH - U-Bolt-Type Pipe and Rod Grounding and Bonding Clamp:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Cooper B-line; brand of Eaton, Electrical Sector.
 - c. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - d. ERICO; brand of nVent Electrical plc.

- e. ILSCO.
 - f. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - g. Panduit Corp.
 - h. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. General Characteristics:
- a. Clamp Material: Brass.
 - b. Listed for outdoor use.
- F. UL KDER and KDSH - Strap-Type Pipe and Rod Grounding and Bonding Clamp:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - b. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - c. ERICO; brand of nVent Electrical plc.
 - d. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - e. Panduit Corp.
2. General Characteristics:
- a. Clamp Material: Copper.
 - b. Listed for outdoor use.
- G. UL KDER - Beam Grounding and Bonding Clamp:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. ABB, Electrification Business.
 - b. Anderson; brand of Hubbell Utility Solutions; Hubbell Incorporated.
 - c. Panduit Corp.
 - d. Penn-Union Corp.; subsidiary of Nesco, Inc.
 - e. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. General Characteristics: Mechanical-type, terminal, ground wire access from four directions; with dual, tin-plated or silicon bronze bolts.
- H. UL KDER - Exothermically Welded Connection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. ABB, Electrification Business.

- b. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - c. ERICO; brand of nVent Electrical plc.
 - d. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. General Characteristics: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.6 GROUNDING AND BONDING BUSHINGS

- A. Description: Bonding bushings connect conduit fittings, tubing fittings, threaded metal conduit, and unthreaded metal conduit to metal boxes and equipment enclosures, and have one or more bonding screws intended to provide electrical continuity between bushing and enclosure. Grounding bushings have provision for connection of bonding or grounding conductor and may or may not also have bonding screws.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
- 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
- D. UL KDER - Bonding Bushing:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Arlington Industries, Inc.
 - c. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - f. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - 2. General Characteristics: Threaded bushing with insulated throat.
- E. UL KDER - Grounding Bushing:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ABB, Electrification Business.
 - b. Arlington Industries, Inc.
 - c. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - f. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. General Characteristics: Threaded bushing with insulated throat and mechanical-type wire terminal.

2.7 GROUNDING AND BONDING HUBS

- A. Description: Hubs with certified grounding or bonding locknut.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
- D. UL KDER - Grounding and Bonding Hub:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Arlington Industries, Inc.
 - c. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - d. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - f. Penn-Union Corp.; subsidiary of Nesco, Inc.
 2. General Characteristics: Insulated, gasketed, watertight hub with mechanical-type wire terminal.

2.8 GROUNDING AND BONDING CONNECTORS

- A. Source Limitations: Obtain products from single manufacturer.
- B. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 - b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.
- C. UL KDER - Pressure-Type Grounding and Bonding Busbar Cable Connector:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - 2. General Characteristics: Copper or copper alloy, for compression bonding of one or more conductor directly to copper busbar. Listed for direct burial.
- D. UL KDER - Lay-In Lug Mechanical-Type Grounding and Bonding Busbar Terminal:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Chatsworth Products, Inc.
 - c. ILSCO.
 - d. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - 2. General Characteristics: Mechanical-type, copper rated for direct burial terminal with set screw.
- E. UL KDER - Crimped Lug Pressure-Type Grounding and Bonding Busbar Terminal:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Harger Lightning & Grounding; business of Harger, Inc.

- c. ILSCO.
 - d. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - 2. General Characteristics: Cast silicon bronze, solderless compression-type wire terminals; with long barrel and two holes spaced on 5/8 or 1 inch (16 or 25 mm) centers for two-bolt connection to busbar.
- F. UL KDER - Split-Bolt Service-Post Pressure-Type Grounding and Bonding Busbar Terminal:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Panduit Corp.
 - b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - 2. General Characteristics: Bolts that surround cable and bond to cable under compression when nut is tightened after assembly is screwed into busbar opening.
- G. UL KDER - Crimped Pressure-Type Grounding and Bonding Cable Connector:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - c. ILSCO.
 - d. allG Fabrication (formerly ALT).
 - 2. General Characteristics: Crimp-and-compress connectors that bond to conductor when connector is compressed around conductor.
 - a. Copper, C and H shaped.
- H. UL KDER - Split-Bolt Pressure-Type Grounding and Bonding Cable Connector:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. ERICO; brand of nVent Electrical plc.
 - c. allG Fabrication (formerly ALT).
 - d. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - 2. General Characteristics: Bolts that surround cable and bond to cable under compression when nut is tightened.
 - a. Copper.

2.9 GROUNDING AND BONDING BUSBARS

- A. Description: Miscellaneous grounding and bonding devices that serve as common connection for multiple grounding and bonding conductors.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
- D. UL KDER - Equipment Room Grounding and Bonding Busbar:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Chatsworth Products, Inc.
 - b. Continental Industries; brand of Hubbell Utility Solutions; Hubbell Incorporated.
 - c. Cooper B-line; brand of Eaton, Electrical Sector.
 - d. ERICO; brand of nVent Electrical plc.
 - e. Hoffman; brand of nVent Electrical plc.
 - f. ILSCO.
 - g. Panduit Corp.
 - h. allG Fabrication (formerly ALT).
 - i. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - 2. General Characteristics:
 - a. Bus: Rectangular bar of annealed copper.
 - b. Mounting Stand-Off Insulators: Lexan or PVC.
 - 1) Comply with UL 891 for use in 600 V switchboards, impulse tested at 5000 V.
 - 3. Options:
 - a. Dimensions: 1/4 by 4 inch (6.3 by 100 mm) in cross section; length as indicated on Drawings.
 - b. Predrilled Hole Pattern: Suitable for installing specified grounding and bonding connectors.

- c. Mounting Hardware: Stand-off brackets that provide 2 inch (50 mm) clearance to access rear of bus. Brackets and bolts must be stainless steel.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 12 AWG and smaller, and stranded conductors for No. 10 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 30 inches below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of doorframe, across top of doorway, and down to specified height above floor; connect to horizontal bus.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.

- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
1. Feeders and branch circuits
 2. Lighting circuits
 3. Receptacle circuits
 4. Single-phase motor and appliance branch circuits
 5. Three-phase motor and appliance branch circuits
 6. Flexible raceway runs
 7. Metal-clad cable runs
 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
 10. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment.
- D. Water Heater, Heat-Tracing, and Anti-frost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

- G. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.
1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch grounding bus.
 3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- H. Metal and Wood Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 2. For grounding electrode system, install at least three (3) rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

3.4 LABELING

- A. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.**
1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.5 FIELD QUALITY CONTROL

- A. Report measured ground resistances that exceed the following values:**
1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms
 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms

4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm
 5. Substations and Pad-Mounted Equipment: 5 ohms
 6. Manhole Grounds: 10 ohms
 7. Ground resistance to earth of each ground rod: > 5 ohms
- B. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Electrical Engineer promptly and include recommendations to reduce ground resistance.

3.6 EXAMINATION

- A. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.
- B. Inspect test results of grounding system measured at point of electrical service equipment connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of electrical service equipment only after unsatisfactory conditions have been corrected.

3.7 SELECTION OF GROUNDING AND BONDING PRODUCTS

- A. Grounding and Bonding Conductors:
1. Provide solid conductor for 8 AWG and smaller, and stranded conductors for 6 AWG and larger unless otherwise indicated.
 2. Custom-Length Insulated Equipment Bonding Jumpers: 6 AWG, 19-strand, Type THHN.
 3. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch (6 mm) in diameter.
 4. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.
 5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch (41 mm) wide and 1/16 inch (1.6 mm) thick.
 6. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch (41 mm) wide and 1/16 inch (1.6 mm) thick.
 7. Underground Grounding Conductors: Install bare copper conductor, 2/0 AWG minimum.
- B. Grounding and Bonding Connectors:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 4. Connections to Structural Steel: Welded connectors.
- C. Grounding and Bonding Busbars: Provide in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated on Drawings.
- 3.8 SELECTION OF GROUNDING AND BONDING PRODUCTS FOR COMMUNICATIONS
- A. Comply with Section 270528 "Pathways for Communications Systems" and Section 271100 "Communications Equipment Room Fittings."
- 3.9 INSTALLATION OF GROUNDING AND BONDING
- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
1. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
 2. Consult Architect for resolution of conflicting requirements.
- C. Special Techniques:
1. Grounding and Bonding Conductors:
 - a. Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
 - b. Underground Grounding Conductors:
 - 1) Bury at least 30 inch (750 mm) below grade.
 - 2) Duct-Bank Grounding Conductor: Bury 12 inch (300 mm) above duct bank when indicated as part of duct-bank installation.
 2. Grounding and Bonding Connectors: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

- a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - b. Make connections with clean, bare metal at points of contact.
 - c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
 - d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
 - f. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1) Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate adjacent parts.
 - 2) Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3) Use exothermic-welded connectors for outdoor locations; if disconnect-type connection is required, use bolted clamp.
 - g. Grounding and Bonding for Piping:
 - 1) Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use bolted clamp connector or bolt lug-type connector to pipe flange by using one of lug bolts of flange. Where dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2) Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with bolted connector.
 - 3) Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
 - h. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
 - i. Grounding for Steel Building Structure: Install driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 ft (18 m) apart.
3. Grounding and Bonding Busbars:
- a. Install busbar horizontally, on insulated spacers 2 inch (50 mm) minimum from wall, 6 inch (150 mm) above finished floor unless otherwise indicated.

- b. Where busbars are indicated on both sides of doorways, route bonding conductor up to top of door frame, across top of doorway, and down; connect to continuation of horizontal busbar.
4. Electrodes:
- a. Ground Rods: Drive rods until tops are 2 inch (50 mm) below finished floor or final grade unless otherwise indicated.
 - 1) Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2) Use exothermic welds for below-grade connections.
 - b. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least same distance from other grounding electrodes, and connect to service grounding electrode conductor.
 - c. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and must be at least 12 inch (300 mm) deep, with cover.
 - 1) Install at least one test well for each service unless otherwise indicated. Install at ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
 - d. Ring Electrode: Install grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around perimeter of building.
 - 1) Install tinned-copper conductor not less than 2/0 AWG for ring electrode and for taps to building steel.
 - 2) Bury ring electrode not less than 24 inch (600 mm) from building's foundation.
 - e. Concrete-Encased Electrode (Ufer Ground):
 - 1) Fabricate in accordance with NFPA 70; use minimum of 20 ft (6 m) of bare copper conductor not smaller than 4 AWG.
 - a) If concrete foundation is less than 20 ft (6 m) long, coil excess conductor within base of foundation.
 - b) Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

- 2) Fabricate in accordance with NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 ft (6.0 m) long. If reinforcing is in multiple pieces, connect together by usual steel tie wires or exothermic welding to create required length.
5. Grounding at Service:
 - a. Equipment grounding conductors and grounding electrode conductors must be connected to ground busbar. Install main bonding jumper between neutral and ground buses.
6. Grounding Underground Distribution System Components:
 - a. Duct-Bank Grounding Conductor: Bury 12 inch (300 mm) above duct bank when indicated as part of duct-bank installation.
 - b. Comply with IEEE C2 grounding requirements.
 - c. Grounding Manholes and Handholes: Install driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inch (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inch (50 mm) above to 6 inch (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.
 - d. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields in accordance with manufacturer's published instructions with splicing and termination kits.
 - e. Pad-Mounted Transformers and Switches: Install two ground rods and ring electrode around pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than 2 AWG for ring electrode and for taps to equipment grounding terminals. Bury ring electrode not less than 6 inch (150 mm) from foundation.
7. Equipment Grounding and Bonding:
 - a. Install insulated equipment grounding conductors with feeders and branch circuits.
 - b. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

- 1) Feeders and branch circuits.
 - 2) Lighting circuits.
 - 3) Receptacle circuits.
 - 4) Single-phase motor and appliance branch circuits.
 - 5) Three-phase motor and appliance branch circuits.
 - 6) Flexible raceway runs.
 - 7) Armored and metal-clad cable runs.
 - 8) Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
- c. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- d. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- e. Isolated Grounding Receptacle Circuits: Install insulated equipment grounding conductor connected to receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of applicable derived system or service unless otherwise indicated.
- f. Isolated Equipment Enclosure Circuits: For designated equipment supplied by branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of applicable derived system or service unless otherwise indicated.

3.10 FIELD QUALITY CONTROL FOR GROUNDING AND BONDING

- A. Field tests and inspections must be witnessed by Project Manager and Owner's Representative.
- 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 calibrated torque wrench in accordance with manufacturer's published instructions.
 3. Test completed grounding system at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before conductors are connected.

- a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by 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 in accordance with IEEE Std 81.
 - c. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.
- C. Nonconforming Work:
 - 1. Grounding system will be considered defective if it does not pass tests and inspections.
 - 2. Remove and replace defective components and retest.
- D. Collect, assemble, and submit test and inspection reports.
 - 1. Report measured ground resistances that exceed the following values:
 - a. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 Ω .
 - b. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 Ω .
 - c. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 Ω .
 - d. Substations and Pad-Mounted Equipment: 5 Ω .

3.11 PROTECTION

- A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.2 SUMMARY

- A. Section Includes:
 - 1. Support, anchorage, and attachment components.
 - 2. Fabricated metal equipment support assemblies.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Sockets.
 - e. Eye nuts.
 - f. Fasteners.

- g. Anchors.
 - h. Saddles.
 - i. Brackets.
- 2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.
 - 1. Hangers. Include product data for components.
 - 2. Slotted support systems.
 - 3. Equipment supports.
 - 4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated Design Submittals: For hangers and supports for electrical systems.
 - 1. Include design calculations and details of hangers.
 - 2. Include design calculations for seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified structural professional engineer to design hanger and support system.
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame Rating: Class 1.
 - 2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32 inch (10 mm) diameter holes at a maximum of 8 inch (200 mm) on center in at least one surface.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ABB, Electrification Business.
 - b. Allied Tube & Conduit; Atkore International.
 - c. CADDY; brand of nVent Electrical plc.
 - d. Cooper B-line; brand of Eaton, Electrical Sector.
 - e. Flex-Strut Inc.
 - f. G-Strut.
 - g. Gripple Inc.
 - h. Haydon Corporation.
 - i. MIRO Industries Inc.
 - j. Metal Ties Innovation.
 - k. Rocket Rack; Robroy Industries.
 - l. Unistrut; Atkore International.
 - m. Wesanco, Inc.
- 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 3. Material for Channel, Fittings, and Accessories: Stainless steel, Type 304.
 - 4. Channel Width: Selected for applicable load criteria.
 - 5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Conduit and Cable Support Devices: Stainless steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
 - C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.
 - D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
 - E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. <Double click here to find, evaluate, and insert list of manufacturers and products.>
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325 (Grade A325M).
6. Toggle Bolts: All Stainless steel springhead type.
7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 SUPPORT INSTALLATION

- A. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
- B. Do not fasten supports to piping, ductwork, mechanical equipment, cable tray or conduit.
- C. The use of pneumatic-actuated anchors is not allowed except at ceilings. Obtain GJT Project Manager approval prior to ordering materials or performing work.
- D. The use of powder-actuated anchors is not allowed.

- E. Do not drill structural steel members.
- F. Install surface-mounted cabinets and panelboards with minimum of four anchors
- G. Suspended conduit or box supports shall not be less than 1/4" diameter steel rod. Rod used as pedestal support is not acceptable. The contractor shall not use tie wire or wire of any type to support conduits, junction boxes or pull boxes.
- H. No more than five (5) 1/2" conduits, three (3) 3/4" conduits or two (2) 1" conduits shall be supported on a single 1/4" diameter steel rod.
- I. All conduits shall be supported by approved hangers. Supports installed and used by other trades such as duct hangers, pipe hangers, ceiling hangers, etc. shall not be used for conduit support.
- J. All light fixtures shall be independently supported at opposite corners from structure, or from trapeze supported from structure by the electrical contractor.
- K. Wall-mounted fixtures shall be supported from building structure with backing support as approved by the GJT Project Manager to prevent any damage to the wall.
- L. Use vibration isolation pads for vibrating equipment such as transformers.
- M. Plastic or fiber anchors are prohibited.
- N. Anchoring in overhead cast in place, pre-tensioned or post-tensioned concrete is prohibited unless x-ray or ground penetrating radar study are performed and approved by the GJT Project Manager.
- O. Route conduit through roof openings provided for piping and ductwork where possible; otherwise, route through roof jack with sealant approved by the roofing manufacturer.

3.2 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

3.3 SELECTION

- A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 - 1. NECA NEIS 101

- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways specified in Section 260533.13 "Conduits for Electrical Systems."
- D. Comply with requirements for boxes specified in Section 260533.16 "Boxes and Covers for Electrical Systems."
- E. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERMIC as required by NFPA 70. Minimum rod size must be 1/4 inch (6 mm) in diameter.
- F. 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 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- G. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2 inch (38 mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.4 INSTALLATION OF SUPPORTS

- A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA NEIS 1, EMT IMC and ERMIC may be supported by openings through structure members, in accordance with NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination must be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.

5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inch (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inch (100 mm) thick.
 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 7. To Light Steel: Sheet metal screws.
 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.5 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M. Submit welding certificates.

3.6 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inch (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000 psi (20.7 MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.7 PAINTING

A. Touchup:

1. 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.
 - a. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
2. Comply with requirements in Section 099113 "Exterior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

- #### B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260529

SECTION 260533.13 - CONDUITS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 PROHIBITED MATERIALS

- A. Intermediate conduits
- B. Aluminum conduit
 - 1. Multi-conductor assemblies, unless written authorization is obtained from GJT Project Manager, or specifically allowed within specification.

1.2 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

1.3 SUMMARY

- A. Section Includes:
 - 1. Type EMT-SS duct raceways and elbows.
 - 2. Type EMT-S duct raceways and elbows.
 - 3. Type LFMC duct raceways.
 - 4. Fittings for conduit, tubing, and cable.
- B. Products Installed, but Not Furnished, under This Section:
 - 1. See Section 260553 "Identification for Electrical Systems" for electrical equipment labels.
- C. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

3. Section 260519 "Low-Voltage for Electrical Power Conductors and Cables" for nonmetallic underground conduit with conductors (Type NUCC).

1.4 DEFINITIONS

- A. Conduit: A structure containing one or more duct raceways.
- B. Duct Raceway: A single enclosed raceway for conductors or cable.
- C. Duct Bank: An arrangement of conduit providing one or more continuous duct raceways between two points.

1.5 ACTION SUBMITTALS

- A. Product Data:
 1. Type EMT-SS duct raceways and elbows.
 2. Type EMT-S duct raceways and elbows.
 3. Fittings for conduit, tubing, and cable.

1.6 INFORMATIONAL SUBMITTALS

- A. Manufacturers' Published Instructions:
 1. Type EMT-SS duct raceways and elbows.
 2. Type EMT-S duct raceways and elbows.
 3. Fittings for conduit, tubing, and cable.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Fittings for Metal Conduit:
 1. Material: Steel
 - a. Type: Set screw or compression.
 - b. Provide throated connectors where entering junction boxes.
 2. 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.

2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Wireway Covers: Hinged type or screw cover.
- B. Finish: Manufacturer's standard enamel finish

2.3 TYPE EMT-SS DUCT RACEWAYS AND ELBOWS

- A. Performance Criteria:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria: UL CCN FJMX; including UL 797A.
- B. Source Quality Control:
 - 1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
 - 2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.
- C. UL FJMX - Stainless Steel Electrical Metal Tubing (EMT-SS) and Elbows:
 - 1. Material: Stainless steel.
 - 2. Options:
 - a. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.4 TYPE EMT-S DUCT RACEWAYS AND ELBOWS

- A. Performance Criteria:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria: UL CCN FJMX; including UL 797.
- B. Source Quality Control:
 - 1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
 - 2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

- C. UL FJMX - Steel Electrical Metal Tubing (EMT-S) and Elbows:
 - 1. Material: Steel.
 - 2. Options:
 - a. Exterior Coating: Zinc.
 - b. Interior Coating: Zinc with organic top coating.
 - c. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.5 TYPE LFMC DUCT RACEWAYS

- A. Performance Criteria:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria: UL CCN DXHR; including UL 360.
- B. Source Quality Control:
 - 1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
 - 2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.
- C. UL DXHR - Steel Liquidtight Flexible Metal Conduit (LFMC-S):
 - 1. Material: Steel.
 - 2. Options:
 - a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
- D. UL DXHR - Stainless Steel Liquidtight Flexible Metal Conduit (LFMC-SS):
 - 1. Material: Stainless steel.
 - 2. Options:
 - a. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.6 FITTINGS FOR CONDUIT, TUBING, AND CABLE

- A. Performance Criteria:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
 2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.
- C. UL DWTT - Fittings for Type ERMC, Type IMC, Type PVC, Type HDPE, Type EPEC, and Type RTRC Duct Raceways:
1. Listing Criteria: UL CCN DWTT; including UL 514B.
 2. Options:
 - a. Material: Steel.
 - b. Coupling Method: Compression coupling or Setscrew coupling. Setscrew couplings with only single screw per conduit are unacceptable.
 - c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.
- D. UL FKA V - Fittings for Type EMT Duct Raceways:
1. Listing Criteria: UL CCN FKA V; including UL 514B.
 2. Options:
 - a. Material: Steel.
 - b. Coupling Method: Compression coupling or Setscrew coupling. Setscrew couplings with only single screw per conduit are unacceptable.
 - c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.
- E. UL DXAS - Fittings for Type LFMC and Type LFNC Duct Raceways:
1. Listing Criteria: UL CCN DXAS; including UL 514B.

PART 3 - EXECUTION

3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of duct raceways. Consult Architect for resolution of conflicting requirements.
- B. Outdoors:
1. Exposed and Subject to Severe Physical Damage: IMC.
 2. Exposed and Subject to Physical Damage: IMC.
 - a. Locations less than 2.5 m (8 ft) above finished floor.
 3. Exposed and Not Subject to Physical Damage: IMC, PVC-80.

4. Concealed Aboveground: EMT.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
- C. Indoors:
1. Exposed and Subject to Severe Physical Damage: IMC. Locations include the following:
 - a. Loading docks.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 2. Exposed and Subject to Physical Damage: IMC. Locations include the following:
 - a. Locations less than 2.5 m (8 ft) above finished floor.
 - b. Stub-ups to above suspended ceilings.
 3. Exposed and Not Subject to Physical Damage: EMT.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Damp or Wet Locations: IMC.
 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC .
- D. Duct Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.
1. ERMC and IMC: Provide threaded-type fittings unless otherwise indicated.
- 3.2 INSTALLATION OF CONDUITS FOR ELECTRICAL SYSTEMS
- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
1. Type EMT-SS: Article 358 of NFPA 70 and NECA NEIS 101.
 2. Type EMT-S: Article 358 of NFPA 70 and NECA NEIS 101.
 3. Type IMC: Article 342 of NFPA 70 and NECA NEIS 101.
 4. Type LFMC: Article 350 of NFPA 70 and NECA NEIS 101.
 5. Type RTRC: Article 355 of NFPA 70 and NECA NEIS 111.
 6. Expansion Fittings: NEMA FB 2.40.
 7. Consult Architect for resolution of conflicting requirements.
- C. Special Installation Techniques:
1. General Requirements for Installation of Duct Raceways:

- a. Complete duct raceway installation before starting conductor installation.
- b. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft (0.6 m) above finished floor.
- c. Install no more than equivalent of three 90-degree bends in conduit run except for control wiring conduits, for which no more than equivalent of two 90-degree fewer bends are permitted. Support within 12 inch (300 mm) of changes in direction.
- d. Make bends in duct raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
- e. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- f. Support conduit within 12 inch (300 mm) of enclosures to which attached.
- g. Install duct sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed duct raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install duct sealing fittings in accordance with NFPA 70.
- h. Install devices to seal duct raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of duct raceways at the following points:
 - 1) Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2) Where an underground service duct raceway enters a building or structure.
 - 3) Conduit extending from interior to exterior of building.
 - 4) Conduit extending into pressurized duct raceway and equipment.
 - 5) Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 - 6) Where otherwise required by NFPA 70.
- i. Do not install duct raceways or electrical items on "explosion-relief" walls or rotating equipment.
- j. Do not install conduits within 2 inch (50 mm) of the bottom side of a metal deck roof.
- k. Keep duct raceways at least 6 inch (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal duct raceway runs above water and steam piping.
- l. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
- m. Install pull wires in empty duct raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb (90 kg) tensile strength.

Leave at least 12 inch (300 mm) of slack at both ends of pull wire. Cap underground duct raceways designated as spare above grade alongside duct raceways in use.

- n. Install duct raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
 - 1) Termination fittings with shoulders do not require two locknuts.
 - o. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- 2. Types EMT-A, ERMCA, and FMC-A: Do not install aluminum duct raceways or fittings in contact with concrete or earth.
 - 3. Types ERMCA and IMC:
 - a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of duct raceway and fittings before making up joints. Follow compound manufacturer's published instructions.
 - 4. Types FMC, LFMC, and LFNC:
 - a. Provide a maximum of 36 inch (915 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
- D. Interfaces with Other Work:
- 1. Coordinate installation of new products with other trades.
 - 2. Coordinate with Section 079200 "Joint Sealants " for installation of firestopping at penetrations of fire-rated floor and wall assemblies.
 - 3. Coordinate with Section 260529 "Hangers and Supports for Electrical Systems" for installation of conduit hangers and supports.

3.3 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533.13

SECTION 260533.16 - BOXES AND COVERS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Junction boxes and pull boxes.
3. Cover plates for device boxes.

B. Products Installed, but Not Furnished, under This Section:

1. See Section 260553 "Identification for Electrical Systems" for electrical equipment labels.

C. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Junction boxes and pull boxes.
3. Cover plates for device boxes.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Junction boxes and pull boxes.
3. Cover plates for device boxes.

PART 2 - PRODUCTS

2.1 BOXES, ENCLOSURES, AND CABINETS

- A. Sheet Metal Outlet and Device Boxes: Galvanized steel. Comply with NEMA OS 1 and UL 514A.
- B. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover. Provide threaded hubs.v
- C. Nonmetallic Outlet and Device Boxes: Prohibited, unless specifically allowed in writing by the GJT Project Manager.
- D. Metal Floor Boxes:
 - 1. Material: Cast metal.
 - 2. Finish: Unless otherwise noted all floor boxes shall be Brass; Brushed aluminum shall be provided for floor boxes providing power to hold room seating.
 - 3. Type: Fully adjustable.
 - 4. Shape: Round.
- E. Nonmetallic Floor Boxes: Prohibited, unless specifically allowed by the GJT Project Manager.
- F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50lb. Outlet boxes designed for attachment of luminaires weighing more than 50lb shall be listed and marked for the maximum allowable weight.
- G. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70lb.
- H. Device Box Dimensions: 4 inches square by 2-1/8 inches deep or as approved by GJT Project Manager.
- I. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, Type 3R or Type 4x as appropriate, with continuous-hinge cover with flush latch unless otherwise indicated. Screw cover enclosures: VL50 & NEMA 1.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic or Fiberglass.
 - 3. Interior Panels: Steel; 14 gage steel, 12 gage if floor mounted, all sides finished with manufacturer's standard enamel, white.

4. Large Pull Boxes: Boxes larger than 100 cubic inches in volume or 12 inches in any dimension.
 - a. Interior Dry Locations: Use hinged or screw covered enclosure.
 - b. Interior damp or wet locations: Use NEMA 3R hinged cover boxes.

2.2 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN QCIT; including UL 514A.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL QCIT - Metallic Outlet Boxes and Covers:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Appleton; Emerson Electric Co., Automation Solutions.
 - c. Arlington Industries, Inc.
 - d. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - e. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - f. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - g. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - h. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - i. Pass & Seymour; Legrand North America, LLC.

- j. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - k. Wiremold; Legrand North America, LLC.
3. Options:
- a. Material: Sheet steel.
 - b. Sheet Metal Depth: Minimum 2.5 inch (65 mm).
 - c. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb (23 kg) or more than 50 lb (23 kg) and marked with maximum allowable weight.

D. UL QCIT - Metallic Conduit Bodies:

- 1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Appleton; Emerson Electric Co., Automation Solutions.
 - c. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - f. Pass & Seymour; Legrand North America, LLC.
 - g. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

E. UL QCIT - Metallic Device Boxes:

- 1. Description: Box with provisions for mounting wiring device directly to box.
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Appleton; Emerson Electric Co., Automation Solutions.
 - c. Arlington Industries, Inc.
 - d. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - e. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - f. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - g. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - h. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.

- i. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- 3. Options:
 - a. Material: Sheet steel.
 - b. Sheet Metal Depth: minimum 2.5 inch.
- F. UL QCIT - Metallic Extension Rings:
 - 1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Appleton; Emerson Electric Co., Automation Solutions.
 - c. Cooper B-line; brand of Eaton, Electrical Sector.
 - d. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - e. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - f. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - g. Pass & Seymour; Legrand North America, LLC.
 - h. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - i. Topaz Lighting & Electric.

2.3 JUNCTION BOXES AND PULL BOXES

- A. Performance Criteria:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - 2. Listing Criteria: UL CCN BGUZ; including UL 50 and UL 50E.
- B. Source Quality Control:
 - 1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
 - 2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.
- C. UL BGUZ - Indoor Sheet Metal Junction and Pull Boxes:
 - 1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adalet.
 - b. Appleton; Emerson Electric Co., Automation Solutions.
 - c. Cooper B-line; brand of Eaton, Electrical Sector.
 - d. FSR Inc.
 - e. Hoffman; brand of nVent Electrical plc.
 - f. Hubbell Industrial Controls; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - g. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - h. Milbank Manufacturing Company.
 - i. N J Sullivan Company.
 - j. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

3. Options:
 - a. Degree of Protection: Type 1.

D. UL BGUZ - Indoor Cast-Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adalet.
 - b. Appleton; Emerson Electric Co., Automation Solutions.
 - c. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - d. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.

3. Options:
 - a. Degree of Protection: Type 1.

E. UL BGUZ - Indoor Polymeric Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ABB, Electrification Business.
 - b. Allied Tube & Conduit; Atkore International.
 - c. Cantex Inc.
 - d. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - e. JM Eagle.
 - f. Robroy Enclosures; Robroy Industries.
 - g. Topaz Lighting & Electric.
 3. Options:
 - a. Degree of Protection: Type 1.
- F. UL BGUZ - Outdoor Sheet Metal Junction and Pull Boxes:
1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adalet.
 - b. Appleton; Emerson Electric Co., Automation Solutions.
 - c. Cooper B-line; brand of Eaton, Electrical Sector.
 - d. FSR Inc.
 - e. Hoffman; brand of nVent Electrical plc.
 - f. Hubbell Industrial Controls; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - g. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - h. Milbank Manufacturing Company.
 - i. N J Sullivan Company.
 - j. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 3. Options:
 - a. Degree of Protection: Type 3R.
- G. UL BGUZ - Outdoor Cast-Metal Junction and Pull Boxes:
1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Adalet.
- b. Appleton; Emerson Electric Co., Automation Solutions.
- c. Crouse-Hinds; brand of Eaton, Electrical Sector.
- d. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.

3. Options:

- a. Degree of Protection: Type 3R.

H. UL BGUZ - Outdoor Polymeric Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Allied Tube & Conduit; Atkore International.
 - c. Cantex Inc.
 - d. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - e. JM Eagle.
 - f. Robroy Enclosures; Robroy Industries.
 - g. Topaz Lighting & Electric.
3. Options:
 - a. Degree of Protection: Type 3R.

2.4 COVER PLATES FOR DEVICES BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN QCIT or UL CCN QCMZ; including UL 514D.
3. Wallplate-Securing Screws: Metal with head color to match wallplate finish.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL QCIT or QCMZ - Metallic Cover Plates for Device Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Appleton; Emerson Electric Co., Automation Solutions.
 - c. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
 - d. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - e. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - f. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - g. Intermatic, Inc.
 - h. Leviton Manufacturing Co., Inc.
 - i. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - j. Panduit Corp.
 - k. Pass & Seymour; Legrand North America, LLC.
 - l. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - m. Topaz Lighting & Electric.
 - n. Wiremold; Legrand North America, LLC.
2. Options:
 - a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
 - b. Wallplate Material: 0.032 inch (0.8 mm) thick, Type 302/304 non-magnetic stainless steel with brushed finish.

D. UL QCIT or QCMZ - Nonmetallic Cover Plates for Device Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Appleton; Emerson Electric Co., Automation Solutions.
 - c. Arlington Industries, Inc.
 - d. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
 - e. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - f. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - g. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - h. Intermatic, Inc.
 - i. Leviton Manufacturing Co., Inc.

- j. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
- k. Panduit Corp.
- l. Pass & Seymour; Legrand North America, LLC.
- m. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- n. Topaz Lighting & Electric.
- o. Wiremold; Legrand North America, LLC.

2. Options:

- a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
- b. Wallplate Material: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device.
- c. Color: Grey.

PART 3 - EXECUTION

3.1 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.

B. Degree of Protection:

1. Outdoors:

- a. Type 3R unless otherwise indicated.
- b. Locations Exposed to Hosedown: Type 4.
- c. Locations Subject to Potential Flooding: Type 6P.
- d. Locations Aboveground Where Mechanism Must Operate When Ice Covered: Type 3S.
- e. Locations in-Ground or Exposed to Corrosive Agents: Type 4X.
- f. Locations in-Ground or Exposed to Corrosive Agents Where Mechanism Must Operate When Ice Covered: Type 3SX.

2. Indoors:

- a. Type 1 unless otherwise indicated.
- b. Damp or Dusty Locations: Type 4.
- c. Locations Exposed to Airborne Dust, Lint, Fibers, or Flyings: Type 4.
- d. Locations Exposed to Hosedown: Type 4.
- e. Locations Exposed to Brief Submersion: Type 6P.

- f. Locations Exposed to Prolonged Submersion: Type 6P.
- g. Locations Exposed to Corrosive Agents: Type 4X.
- h. Locations Exposed to Spraying Oil or Coolants: Type 13.

C. Exposed Boxes Installed Less Than 2.5 m (8 ft) Above Floor:

- 1. Boxes with knockouts or unprotected openings are prohibited.
- 2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.2 INSTALLATION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:

- 1. Outlet, Device, Pull, and Junction Boxes: Article 314 of NFPA 70.
- 2. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:

- 1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
- 2. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- 3. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.
- 4. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- 5. Locate boxes so that cover or plate will not span different building finishes.
- 6. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
- 7. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
- 8. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
- 9. Set metal floor boxes level and flush with finished floor surface.
- 10. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- 11. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
- 12. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.

13. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:

- a. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
- b. Provide gaskets for wallplates and covers.

14. Identification: Provide labels for boxes and associated electrical equipment.

- a. Identify field-installed conductors, interconnecting wiring, and components.
- b. Provide warning signs.
- c. Label each box with engraved metal or laminated-plastic nameplate..

D. Interfaces with Other Work:

- 1. Coordinate installation of new products with other trades.

3.3 CLEANING

- A. Remove construction dust and debris from boxes before installing wallplates, covers, and hoods.

3.4 PROTECTION

- A. After installation, protect boxes from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260533.16

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Labels.
2. Extruded insulating tubing.
3. Bands.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

- A. Product Data:** For each type of product.
- B. Samples:** For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule:** For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 LABELS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 2. Listing Criteria: UL CCN PGDQ2 for components; including UL 969.
- B. UL PGDQ2 - Vinyl Wraparound Labels: Preprinted, flexible labels laminated with clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Panduit Corp.
 - c. Seton Identification Products; a Brady Corporation company.
- C. UL PGDQ2 - Self-Adhesive Wraparound Labels: Preprinted, 3 mil (0.08 mm) thick, polyester flexible label with acrylic pressure-sensitive adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Panduit Corp.
 - c. Brother International Corporation.
 2. Self-Lamination: Clear; UV-, weather-, and chemical-resistant; self-laminating, with protective shield over legend. Size labels such that clear shield overlaps entire printed legend.
 3. Marker for Labels:
 - a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - b. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. UL PGDQ2 - Self-Adhesive Labels: Polyester, 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Panduit Corp.
 - c. Brother International Corporation.
 - d. Ideal Industries, Inc.
 2. Minimum Nominal Size:

- a. 1-1/2 by 6 inch (37 by 150 mm) for raceway and conductors.
- b. 3-1/2 by 5 inch (76 by 127 mm) for equipment.
- c. As required by authorities having jurisdiction.

2.2 EXTRUDED INSULATING TUBING

A. Performance Criteria:

- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- 2. Listing Criteria: UL CCN YDPU2 for components; including UL 224.

B. UL YDPU2 - Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 deg F (93 deg C).

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Panduit Corp.

2.3 BANDS

A. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Brady Corporation.
 - b. Marking Services Inc.
 - c. Panduit Corp.
 - d. Seton Identification Products; a Brady Corporation company.

B. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inch (50 mm) long, with diameters sized to suit diameters and that stay in place by gripping action.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Marking Services Inc.
 - c. Panduit Corp.

2.4 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. Ideal Industries, Inc.
 - d. Marking Services Inc.
 - e. Panduit Corp.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil (0.08 mm) thick by 1 to 2 inch (25 to 50 mm) wide; compounded for outdoor use.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. Marking Services Inc.
- C. Tape and Stencil: 4 inch (100 mm) wide black stripes on 10 inch (250 mm) centers placed diagonally over orange background and are 12 inch (300 mm) wide. Stop stripes at legends.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. LEM Products Inc.
 - b. Marking Services Inc.
 - c. Seton Identification Products; a Brady Corporation company.
- D. Floor Marking Tape: 2 inch (50 mm) wide, 5 mil (0.125 mm) pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. Seton Identification Products; a Brady Corporation company.
- E. Underground-Line Warning Tape:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Brady Corporation.
 - b. Ideal Industries, Inc.
 - c. LEM Products Inc.
 - d. Marking Services Inc.
 - e. Pipemarker.com; Brimar Industries, Inc.
 - f. Reef Industries, Inc.
 - g. Seton Identification Products; a Brady Corporation company.
2. Tape:
 - a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape must be permanent and may not be damaged by burial operations.
 - c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
3. Color and Printing:
 - a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
 - b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".
 - c. Inscriptions for Orange Tapes: "CAUTION BURIED CATV LINE BELOW" or "CAUTION BURIED TELEPHONE LINE BELOW" or "CAUTION BURIED FIBER OPTIC LINE BELOW" or "CAUTION BURIED COMMUNICATION LINE BELOW" based on applicable system.
4. Nonconducting Line-Warning Tape:
 - a. Pigmented polyolefin, bright colored, continuous-printed on one side with inscription of utility, compounded for direct-burial service.
 - b. Width: 3 inch (75 mm).
 - c. Thickness: 4 mil (0.1 mm).
 - d. Weight: 18.5 lb/1000 sq. ft (9.0 kg/100 sq. m).
 - e. Tensile in accordance with ASTM D882: 30 lbf (133.4 N) and 2500 psi (17.2 MPa).
5. Detectable Line-Warning Tape:
 - a. Detectable three-layer laminate, consisting of printed pigmented polyolefin film, solid aluminum-foil core, and clear protective film that allows inspection of continuity of conductive core; bright colored, continuous-printed on one side with inscription of utility, compounded for direct-burial service.
 - b. Width: 3 inch (75 mm).
 - c. Overall Thickness: 5 mil (0.125 mm).
 - d. Foil Core Thickness: 0.35 mil (8.9 m).
 - e. Weight: 28 lb/1000 sq. ft (13.7 kg/100 sq. m).

- f. Tensile in accordance with ASTM D882: 70 lbf (311.3 N) and 4600 psi (31.7 MPa).
- F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height must be 1 inch (25 mm).

2.5 TAGS

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. Marking Services Inc.
 - d. Seton Identification Products; a Brady Corporation company.
- B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch (0.38 mm) thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. LEM Products Inc.
 - d. Marking Services Inc.
 - e. Panduit Corp.
 - f. Seton Identification Products; a Brady Corporation company.
- C. Write-on Tags:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. LEM Products Inc.
 - d. Pipemarker.com; Brimar Industries, Inc.
 - e. Seton Identification Products; a Brady Corporation company.
 - 2. Polyester Tags: 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment.
 - 3. Marker for Tags:

- a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
- b. Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.6 SIGNS

A. Baked-Enamel Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. Champion America.
 - d. Marking Services Inc.
2. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
3. 1/4 inch (6.4 mm) grommets in corners for mounting.
4. Nominal Size: 7 by 10 inch (180 by 250 mm).

B. Metal-Backed Butyrate Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Champion America.
 - c. Marking Services Inc.
2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396 inch (1 mm) galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
3. 1/4 inch (6.4 mm) grommets in corners for mounting.
4. Nominal Size: 10 by 14 inch (250 by 360 mm).

C. Laminated Acrylic or Melamine Plastic Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. Marking Services Inc.
 - d. Seton Identification Products; a Brady Corporation company.
2. Engraved legend.

3. Thickness:

- a. For signs up to 20 sq. inch (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
- b. For signs larger than 20 sq. inch (129 sq. cm), 1/8 inch (3.2 mm) thick.
- c. Engraved legend with black letters on white face.
- d. Punched or drilled for mechanical fasteners with 1/4 inch (6.4 mm) grommets in corners for mounting.
- e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 CABLE TIES

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

1. HellermannTyton.
2. Ideal Industries, Inc.
3. Marking Services Inc.
4. Panduit Corp.

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN ZODZ; including UL 1565 or UL 62275.

C. UL ZODZ - General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C) in accordance with ASTM D638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

D. UL ZODZ - UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C) in accordance with ASTM D638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black.

- E. UL ZODZ - Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
1. Minimum Width: 3/16 inch (5 mm).
 2. Tensile Strength at 73 deg F (23 deg C) in accordance with ASTM D638: 7000 psi (48.2 MPa).
 3. UL 94 Flame Rating: 94V-0.
 4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
 5. Color: Black.

2.8 EQUIPMENT IDENTIFICATION LABELS

- A. Emergency Equipment labels shall be white letters on red background. Black letters on an orange field.
- B. Provide nameplates with a minimum letter height as indicated below. Examples are given below for the size of letters to use for a given application and this not a list of the equipment to be identified. All equipment is required to be identified.
1. For equipment designation: switchboards and motor control centers: 1/2-inch, panel boards: 1/4 inch. For voltage, bus ampacity, feeder source, and circuit number: 1/8 inch.
 2. Individual circuit breakers and or motor starters in motor control centers: For equipment designation and section number: 1/4 inch, for load served and location of load: 1/8 inch. Inside the door, a typed label shall provide complete motor data including nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.
 3. Individual breakers in switchgears and switchboards: for breaker number (address number) and equipment designation; 1/4 inch, for breaker frame size and trip setting; 1/8 inch
 4. Individual circuit breaker and spaces in panel boards: for numbers (section number) 1/4 inch.
 5. Individual circuit breakers in distribution panel boards: 1/4 inch for panel being fed and 1/8 inch for its location.
 6. Transformers: 1/4 inch for equipment designation and size; 1/8 inch for primary and secondary voltages, primary source and circuit number, secondary load, and its location.
 7. Individual remote indicating lights, meters, instruments, and control switches: 1/8 inch, indicate unit, equipment, or fire detector being monitored and condition indicated by illumination.
 8. Individual switches and pilots: 1/8 inch, identify mechanical unit being served.
 9. Disconnects, relay panels, lighting contactors: 1/4 inch for voltage and source circuit number.

PART 3 - EXECUTION

3.1 IDENTIFICATION SCHEDULE

- A. Wire and Cable Marker:
 - 1. For wire/cables smaller than No. 2/0 use manufacturer's standard cable/conductor markers of wrap-around, pre-numbered plastic-coated type are to be used and numbered to show circuit identification.
 - 2. For cables No. 4 AWG and larger heat shrink sleeving is to be used for phase color-coding.
- B. Cable/Conductor Identification:
 - 1. The application of cable/conductor identification, with circuit number, on each wire / cable in each box/enclosure/cabinet is required. The identification shall match the marking system used in panel boards, shop drawings, and contract documents.
 - a. Provide labels on all wires, including in boxes where wires are pulled through but not terminated, such as junction boxes.
- C. System Color Coding Schedule:
 - 1. Electrical emergency power conduits, including all feeders and branch circuits serving or connected to emergency systems as defined in NEC 700.2, shall have "RED" stripes on each section every 5 feet of electrical conduit (visible from the floor or above a suspended ceiling) and within 3 feet of all equipment. All associated junction or pull boxes shall have the cover painted red.
 - 2. ECS conduits installed to serve systems specified in Section 275123 "Emergency Communications System" shall have "GREEN" bands on 5' centers for the entire length of conduit run, or be continuously painted green. All junction or pull boxes shall have the cover painted green with the associated zone number written neatly on the box cover with permanent marker.
 - 3. Conduits serving temperature control, metering data cabling, lighting control BACNet cabling, and other EMCS integration cabling systems shall have "BROWN" bands, 5' on centers for the entire length, or be continuously painted brown. All junction or pull boxes shall have the cover painted brown.
 - 4. Fire Alarm conduit shall be a continuous red factory finish.

3.2 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.3 SELECTION OF COLORS AND IDENTIFICATION MARKINGS

- A. Comply with 29 CFR 1910.144 for color identification of hazards, and the following:
 - 1. Fire-protection and fire-alarm equipment, including raceways, must be finished, painted, or suitably marked safety red.
 - 2. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than 7.7 ft (2.3 m) above finished floor.
- B. Pipe and Conduit Labeling: Comply with ASME A13.1 and IEEE C2.
- C. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - 1. Color must be factory applied or field applied for sizes larger than 6 AWG when permitted by authorities having jurisdiction.
 - 2. Colors for 208Y/120 V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 240 V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - 4. Colors for 480Y/277 V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 5. Color for Neutral (Grounded Conductor): White.
 - 6. Color for Equipment Ground: Bare copper or Green.
 - 7. Color for Isolated Ground: Green with two or more yellow stripes.
- D. Color-Coding Raceways, Cable Trays, Junction Boxes, and Conductors for Intrinsically-Safe Circuits: Light blue. When used to identify intrinsically-safe circuits, Article 504 of NFPA 70 requires that the color light blue not be used for any other purpose.
- E. Color-Coding Instructional Signs: Self-adhesive labels, including color code for grounded and ungrounded conductors.
- F. Accessible Fittings for Raceways: Identify cover of junction and pull box of the following systems with wiring system legend and system voltage. System legends must be as follows:

1. "EMERGENCY POWER."
 2. "POWER."
 3. "UPS."
- G. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- H. Locations of Underground Lines: Underground-line warning tape for power and lighting.
- I. Vaults, Manholes, Handholes, and Pull and Junction Boxes, 1000 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels and snap-around color-coding bands to identify phase.
1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft (15 m) maximum intervals in straight runs, and at 25 ft (7.6 m) maximum intervals in congested areas.
 2. Identify system voltage and system or service type with black letters on orange field.
- J. Accessible Raceways and Metal-Clad Cables, 1000 V or Less, for Service, Feeder, and Branch Circuits, More Than 15 A and 120 V to Ground: Identify with self-adhesive raceway labels or vinyl tape applied in bands.
1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft (15 m) maximum intervals in straight runs, and at 25 ft (7.6 m) maximum intervals in congested areas.
 2. Identify system voltage and system or service type with black letters on orange field.
- K. Cover Plates: Label individual cover plates with self-adhesive labels. Place label at top of cover plate. Label cover plate with the following information, in the order listed:
1. Panelboard designation.
 2. Colon or dash.
 3. Branch circuit number.
- L. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in direction of access to live parts. Workspace must comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- M. Equipment Identification Labels:
1. Black letters on white field.
 2. Indoor Equipment: Laminated acrylic or melamine plastic sign.
 3. Outdoor Equipment: Laminated acrylic or melamine sign.
 4. Equipment to Be Labeled:

- a. Racks, Frames, and Enclosures: Identify front and rear of each with self-adhesive labels containing equipment designation.
- b. Panelboards: Typewritten directory of circuits in location provided by panelboard manufacturer. Panelboard identification must be in form of self-adhesive, engraved, laminated acrylic or melamine label.
- c. Enclosures and electrical cabinets.
- d. Access doors and panels for concealed electrical items.
- e. Emergency system boxes and enclosures.
- f. Motor-control centers.
- g. Enclosed switches.
- h. Enclosed circuit breakers.
- i. Enclosed controllers.
- j. Variable-speed controllers.
- k. Push-button stations.
- l. Power-transfer equipment.
- m. Contactors.
- n. Remote-controlled switches, dimmer modules, and control devices.
- o. Battery-inverter units.
- p. Monitoring and control equipment.

N. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.4 SELECTION OF SIGNS AND HAZARD MARKINGS

- A. Comply with 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs.
- B. Signs, labels, and tags required for personnel safety must comply with the following standards:

1. Safety Colors: NEMA Z535.1.
2. Facility Safety Signs: NEMA Z535.2.
3. Safety Symbols: NEMA Z535.3.
4. Product Safety Signs and Labels: NEMA Z535.4.
5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.

C. Electrical Hazard Warnings:

1. Arc-Flash Hazard Warning: Self-adhesive labels. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash hazard warning labels.
2. Raceways and Cables Carrying Circuits at More Than 1000 V:
 - a. Black letters on orange field.
 - b. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

3. Multiple Power Sources Warning Legend: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 4. OSHA Workspace Clearance Warning Legend: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 3 FEET MINIMUM."
- D. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
1. Apply to exterior of door, cover, or other access.
 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Power-transfer switches.
 - b. Controls with external control power connections.
- E. Operating Instruction Signs: Self-adhesive labels.
- F. Emergency Operating Instruction Signs: Self-adhesive labels with white legend on red background with minimum 3/8 inch (10 mm) high letters for emergency instructions at equipment used for power transfer.
- 3.5 SELECTION OF IDENTIFICATION PRODUCTS FOR COMMUNICATIONS, CONTROL, AUXILIARY, AND LIFE SAFETY SYSTEMS
- A. Comply with Communications Specifications.
- 3.6 INSTALLATION
- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
 - B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes typical for electrical equipment environments specified in Section 260011 "Facility Performance Requirements for Electrical."
 - C. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
 - D. Fasteners for Labels and Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.
 - E. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings,

Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

- F. Install identifying devices before installing acoustical ceilings and similar concealment.
- G. Verify identity of item before installing identification products.
- H. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- I. Apply identification devices to surfaces that require finish after completing finish work.
- J. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.
- L. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to location and substrate.
- M. Snap-Around Labels: Secure tight to surface at location with high visibility and accessibility.
- N. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.
- O. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.
- P. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.
- Q. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.
- R. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of 6 inch (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- S. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

- T. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's instructions.
- U. Underground Line Warning Tape:
 - 1. During backfilling of trenches, install continuous underground-line warning tape not less than 12 inch (300 mm) directly above cables or raceways buried 18 inch (450 mm) or more below grade. Use multiple tapes where width of multiple lines installed in common trench or concrete envelope exceeds 16 inch (400 mm) overall.
 - 2. Limit use of underground-line warning tape to direct-buried cables.
 - 3. Install underground-line warning tape for direct-buried cables and cables in raceways.
- V. Metal Tags:
 - 1. Place in location with high visibility and accessibility.
 - 2. Secure using UV-stabilized cable ties.
- W. Nonmetallic Preprinted Tags:
 - 1. Place in location with high visibility and accessibility.
 - 2. Secure using UV-stabilized cable ties.
- X. Write-on Tags:
 - 1. Write on Tags are not allowed on permanently installed equipment.
- Y. Baked-Enamel Signs: Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
- Z. Metal-Backed Butyrate Signs: Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
- AA. Laminated Acrylic or Melamine Plastic Signs: Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Indoor occupancy and vacancy sensors.
 - 2. Conductors and cables.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 260011 "Facility Performance Requirements" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
 - 3. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Indoor occupancy and vacancy sensors.
 - 2. Conductors and cables.
- B. Shop Drawings:
 - 1. Show installation details for the following:
 - a. Occupancy sensors.
 - 2. Interconnection diagrams showing field-installed wiring.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Field quality-control reports.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's warranties.

1.4 WARRANTY

- A. Special Extended Warranty: Manufacturer and Installer warrant that installed lighting control devices perform in accordance with specified requirements and agree to repair or replace, including labor, materials, and equipment, devices that fail to perform as specified within extended warranty period.
1. Failures include, but are not limited to, the following:
 - a. Faulty operation of lighting control software.
 - b. Faulty operation of lighting control devices.
 2. Extended Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SWITCH BOX MOUNTED OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton.
 2. Leviton Manufacturing Co., Inc.
 3. Lutron Electronics Co., Inc.
 4. Philips; Signify North America; Signify Holding.
 5. nLight; Acuity Brands Lighting, Inc.
- B. General Requirements for Sensors:
1. Wall or Ceiling -mounted, solid-state indoor occupancy and vacancy sensors.
 2. Dual technology.
 3. Separate power pack.
 4. Hardwired connection to switch.
 5. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 6. Operation:
 - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - c. Combination Sensor: Unless otherwise indicated, sensor must be programmed to turn lights on when coverage area is occupied and turn

them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A.
 8. Power: Line voltage.
 9. Power Pack: Dry contacts rated for 20 A LED load at 120 and 277 V(ac), for 13 A tungsten at 120 V(ac), and for 1 hp at 120 V(ac). Sensor has 24 V(dc), 150 mA, Class 2 power source.
 10. Mounting:
 - a. Sensor: Suitable for mounting in any position in a standard device box or outlet box.
 - b. Relay: Externally mounted through a 1/2 inch (13 mm) knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 12. Bypass Switch: Override the "on" function in case of sensor failure.
 13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); turn lights off when selected lighting level is present.
- C. Dual-Technology Type: Wall or Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6 inch (150 mm) minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch (23 200 sq. mm), and detect a person of average size and weight moving not less than 12 inch (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inch/s (305 mm/s).
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96 inch (2440 mm) high ceiling.
 4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 2000 sq. ft. (220 sq. m) when mounted 48 inch (1200 mm) above finished floor.

2.2 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF SENSORS

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's instructions.

3.3 INSTALLATION OF WIRING

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).
- B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's instructions.
- C. Size conductors in accordance with lighting control device manufacturer's instructions unless otherwise indicated.

- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, device, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring in accordance with Section 260553 "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

- A. Field tests must be witnessed by Architect, Owner's Representative, and Construction Manager..
- B. Tests and Inspections:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Nonconforming Work:
 - 1. Lighting control devices will be considered defective if they do not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- D. Prepare test and inspection reports.
- E. Manufacturer Services:
 - 1. Engage factory-authorized service representative to support field tests and inspections.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.7 MAINTENANCE

A. Software and Firmware Service Agreement:

1. Technical Support: Beginning at Substantial Completion, verify that software and firmware service agreement includes software support for two years.
2. Upgrade Service: At Substantial Completion, update software and firmware to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Verify upgrading software includes operating system and new or revised licenses for using software.
 - a. Upgrade Notice: No fewer than 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.
3. Upgrade Reports: Prepare written report after each update, documenting upgrades installed.

END OF SECTION 260923

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General-use switches, dimmer switches, and fan-speed controller switches.
2. General-grade single straight-blade receptacles.
3. General-grade duplex straight-blade receptacles.
4. Receptacles ground-fault protective devices.

B. Special-purpose power outlet assemblies. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 260923 "Lighting Control Devices" for occupancy sensors, timers, control-voltage switches, and control-voltage dimmers.

1.2 ALLOWANCES

- A. See Section 012100 "Allowances" for description of allowances affecting items specified in this Section.**

1.3 DEFINITIONS

- A. Commercial/Industrial-Use Cord Reel:** A cord reel subject to severe use in factories, commercial garages, construction sites, and similar locations requiring a harder service-type cord.
- B. UL 1472 Type I Dimmer:** Dimmer in which air-gap switch is used to energize preset lighting levels.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference:** Conduct conference at Project site.
- B. Preinstallation Coordination Meeting(s):** For ceiling-mounted cable reels. Conduct meeting at Project site before final locations have been determined.

1. Attendees: Installers, fabricators, representatives of manufacturers, and administrators for field tests and inspections. Notify Architect, Construction Manager, and Owner's Commissioning Authority of scheduled meeting dates.

1.5 ACTION SUBMITTALS

A. Product Data:

1. General-use switches, dimmer switches, and fan-speed controller switches.
2. General-grade single straight-blade receptacles.
3. General-grade duplex straight-blade receptacles.

B. Shop Drawings:

1. Wiring diagrams for duplex straight-blade receptacles with integral switching means.

C. Field quality-control reports.

1.6 INFORMATIONAL SUBMITTALS

A. Manufacturers' Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:

1. Dimmers.
2. Single straight-blade receptacles.
3. Duplex straight-blade receptacles.
4. Receptacles with GFCI device.

B. Sample warranties.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Special Tools:

1. Proprietary equipment and software required to maintain, repair, adjust, or implement future changes to controlled receptacles.
2. Proprietary equipment required to maintain, repair, adjust, or implement future changes to cord connectors.

1.8 WARRANTY FOR DEVICES

- A. Special Manufacturer Extended Warranty: Manufacturer warrants that devices perform in accordance with specified requirements and agrees to provide repair or replacement of devices that fail to perform as specified within extended warranty period.
1. Initial Extended Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 GENERAL-USE SWITCHES, DIMMER SWITCHES, AND FAN-SPEED CONTROLLER SWITCHES

- A. Toggle Switch:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper wiring devices.
 - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour; Legrand North America, LLC.
 2. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 3. General Characteristics:
 - a. Reference Standards: UL CCN WMUZ and UL 20.
 4. Options:
 - a. Device Color: Gray.
 - b. Configuration:
 - 1) General-duty, 120-277 V, 20 A, single pole.
 5. Accessories:
 - a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.2 GENERAL-GRADE SINGLE STRAIGHT-BLADE RECEPTACLES

A. Single Straight-Blade Receptacle:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper wiring devices.
 - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour; Legrand North America, LLC.
2. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
3. General Characteristics:
 - a. Reference Standards: UL CCN RTRT and UL 498.
4. Options:
 - a. Device Color: Gray.
 - b. Configuration:
 - 1) General-duty, NEMA 5-20R.
 - 2) Heavy-duty, NEMA 5-30R.
5. Accessories:
 - a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.3 GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

A. Duplex Straight-Blade Receptacle:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper wiring devices.
 - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - c. Leviton Manufacturing Co., Inc.

- d. Pass & Seymour; Legrand North America, LLC.
- 2. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- 3. General Characteristics:
 - a. Reference Standards: UL CCN RTRT and UL 498.
- 4. Options:
 - a. Device Color: Gray.
 - b. Configuration:
 - 1) General-duty, NEMA 5-20R.
 - 2) Heavy-duty, NEMA 5-20R.
- 5. Accessories:
 - a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.
- B. Tamper-Resistant Duplex Straight-Blade Receptacle:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper wiring devices.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour; Legrand North America, LLC.
 - d. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - 2. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 3. General Characteristics:
 - a. Reference Standards: UL CCN RTRT and UL 498.

4. Options:

- a. Device Color: Gray.
- b. Configuration:
 - 1) General-duty, NEMA 5-20R.

5. Accessories:

- a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
- b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.4 RECEPTACLES WITH GROUND-FAULT PROTECTIVE DEVICES

A. General-Grade, Duplex Straight-Blade Receptacle with GFCI Device:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper wiring devices.
 - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour; Legrand North America, LLC.
- 2. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- 3. General Characteristics:
 - a. Reference Standards: UL CCN KCXX, UL 498, UL 943, UL 1699, and UL Subject 1699A.
- 4. Options:
 - a. Device Color: Gray.
 - b. Configuration: Heavy-duty, NEMA 5-20R.
- 5. Accessories:
 - a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.

- b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.5 FINISHES

- A. Device Color:
 - 1. All wiring Devices Connected to Normal Power System: Gray
 - 2. All wiring Devices Connected to Emergency Power System: Red

2.6 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Type 302/304 stainless steel 0.04 inch thick.
 - 3. Material for Unfinished Spaces: Type 302/304 stainless steel 0.04 inch thick.
 - 4. Material for Damp Locations: Type 302/304 stainless steel 0.04 inch thick.
 - 5. Plastic covers will not be accepted.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, Type 302/304 satin stainless steel with lockable cover.

2.7 EXAMINATION

- A. Receptacles:
 - 1. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

2.8 INSTALLATION OF SWITCHES

- A. Comply with manufacturer's instructions.
- B. Reference Standards:
 - 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
 - 2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
 - 3. Consult Architect for resolution of conflicting requirements.
- C. Identification:
 - 1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

2.9 INSTALLATION OF STRAIGHT-BLADE RECEPTACLES

- A. Comply with manufacturer's instructions.
- B. Reference Standards:
 - 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
 - 2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
 - 3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
 - 4. Consult Architect for resolution of conflicting requirements.
- C. Identification:
 - 1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."
- D. Interfaces with Other Work:
 - 1. Do not install Type 3 SPD, including surge-protected relocatable taps and power strips, on branch circuit downstream of GFCI device.
 - 2. Coordinate installation of new products for with existing conditions.

2.10 FIELD QUALITY CONTROL OF SWITCHES

- A. Field tests and inspections must be witnessed by Architect, Owner and Construction Manager..
- B. Tests and Inspections:
 - 1. Perform tests and inspections in accordance with manufacturers' instructions.
- C. Nonconforming Work:
 - 1. Unit will be considered defective if it does not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- D. Assemble and submit test and inspection reports.
- E. Manufacturer Services:
 - 1. Engage factory-authorized service representative to support field tests and inspections.

2.11 FIELD QUALITY CONTROL OF STRAIGHT-BLADE RECEPTACLES

- A. Field tests and inspections must be witnessed by Architect, Owner and Construction Manager.
- B. Tests and Inspections:
 - 1. Insert and remove test plug to verify that device is securely mounted.
 - 2. Verify polarity of hot and neutral pins.
 - 3. Measure line voltage.
 - 4. Measure percent voltage drop.
 - 5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.
 - 6. Perform additional installation and maintenance inspections and diagnostic tests in accordance with NECA NEIS 130 and manufacturers' instructions.
- C. Nonconforming Work:
 - 1. Device will be considered defective if it does not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- D. Assemble and submit test and inspection reports.
- E. Manufacturer Services:
 - 1. Engage factory-authorized service representative to support field tests and inspections.

2.12 FIELD QUALITY CONTROL OF LOCKING RECEPTACLES

- A. Field tests and inspections must be witnessed by Architect, Construction Manager and Owner's Representative.
- B. Tests and Inspections:
 - 1. Insert and remove test plug to verify that device is securely mounted.
 - 2. Verify polarity of hot and neutral pins.
 - 3. Measure line voltage.
 - 4. Measure percent voltage drop.
 - 5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.
 - 6. Perform additional installation and maintenance inspections and diagnostic tests in accordance with NECA NEIS 130 and manufacturers' instructions.
- C. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Assemble and submit test and inspection reports.

E. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

2.13 SYSTEM STARTUP FOR SWITCHES

A. Perform startup service.

1. Complete installation and startup checks for momentary switches, dimmer switches, and fan-speed controller switches in accordance with manufacturer's instructions.

2.14 ADJUSTING

A. Occupancy Adjustments for Controlled Receptacles: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

B. Cord Reels and Fittings: Adjust spring mechanisms and moving parts of cord reels and fittings to function smoothly, and lubricate as recommended in writing by manufacturer.

2.15 PROTECTION

A. Devices:

1. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.
2. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

B. Connectors, Cords, and Plugs:

1. After installation, protect connectors, cords, and plugs from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 262726

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Enclosures.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 DEFINITIONS

- A. GFEP:** Ground-fault circuit-interrupter for equipment protection.
- B. GFLS:** Ground-fault circuit-interrupter for life safety.
- C. SPDT:** Single pole, double throw.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
2. Enclosure types and details for types other than UL 50E, Type 1.
3. Current and voltage ratings.
4. Short-circuit current ratings (interrupting and withstand, as appropriate).
5. Include evidence of qualified electrical testing laboratory listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

- B. Shop Drawings: For enclosed switches and circuit breakers.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include wiring diagrams for power, signal, and control wiring.
- C. Field Quality-Control Submittals:
 - 1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Warranty documentation.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare Parts: Furnish to Owner spare parts, for repairing enclosed switches and circuit breakers, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Fuse Pullers: One for each size and type.

1.7 WARRANTY

- A. Special Installer Extended Warranty: Installer warrants that fabricated and installed enclosed switches and circuit breakers perform in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period.
 - 1. Extended-Warranty Period: Two years from date of Substantial Completion; full coverage for labor, materials, and equipment.
- B. Special Manufacturer Extended Warranty: Manufacturer warrants that enclosed switches and circuit breakers perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.
 - 1. Extended-Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain products from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB, Electrification Business.
 - 2. Eaton.
 - 3. Siemens Industry, Inc., Energy Management Division.
 - 4. Square D; Schneider Electric USA.
- B. Type HD, Heavy Duty:
 - 1. Single throw.
 - 2. Three pole.
 - 3. 600 V(ac).
 - 4. 1200 A and smaller.
 - 5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
 - 6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
 - 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 5. Service-Rated Switches: Labeled for use as service equipment.
 - 6. Hookstick Handle: Allows use of hookstick to operate handle.

7. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ABB, Electrification Business.
 2. Eaton.
 3. Siemens Industry, Inc., Energy Management Division.
 4. Square D; Schneider Electric USA.
- B. Type HD, Heavy Duty, Three Pole, Single Throw, 600 V(ac), 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
 4. Hookstick Handle: Allows use of hookstick to operate handle.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.4 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ABB, Electrification Business.
 2. Eaton.
 3. Siemens Industry, Inc., Energy Management Division.
 4. Square D; Schneider Electric USA.
- B. Circuit breakers must be constructed using glass-reinforced insulating material. Current carrying components must be completely isolated from handle and accessory mounting area.
- C. Circuit breakers must have toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. Circuit-breaker handle must be over center, be trip free, and reside in tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon must be clearly marked on and

off in addition to providing international I/O markings. Equip circuit breaker with push-to-trip button, located on face of circuit breaker to mechanically operate circuit-breaker tripping mechanism for maintenance and testing purposes.

- D. Maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings must be clearly marked on face of circuit breaker. Circuit breakers must be 100 percent rated.
- E. Circuit breaker/circuit breaker combinations for series connected interrupting ratings must be listed by UL as recognized component combinations. Series rated combination used must be marked on end-use equipment along with statement "Caution - Series Rated System. _____ Amps Available. Identical Replacement Component Required."
- F. MCCBs must be equipped with device for locking in isolated position.
- G. Lugs must be suitable for 75 deg C rated wire.
- H. Standard: Comply with UL 489 with required interrupting capacity for available fault currents.
- I. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- J. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- K. Electronic Trip Circuit Breakers: Field-replaceable rating plug, RMS sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I-squared t response.
- L. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- M. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- N. GFLS Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6 mA trip).
- O. GFEP Circuit Breakers: With Class B ground-fault protection (30 mA trip).
- P. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
3. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
4. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
5. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
7. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key must be removable only when circuit breaker is in off position.
8. Zone-Selective Interlocking: Integral with [electronic] [ground-fault] trip unit; for interlocking ground-fault protection function.
9. Electrical Operator: Provide remote control for on, off, and reset operations.

2.5 MOLDED-CASE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB, Electrification Business.
 2. Eaton.
 3. Siemens Industry, Inc., Energy Management Division.
 4. Square D; Schneider Electric USA.
- B. Description: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- C. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- D. Features and Accessories:
1. Standard frame sizes and number of poles.
 2. Lugs:
 - a. Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - b. Lugs must be suitable for 75 deg C rated wire.

3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
7. Key Interlock Kit: Externally mounted to prohibit switch operation; key must be removable only when switch is in off position.
8. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
9. Electrical Operator: Provide remote control for on, off, and reset operations.

2.6 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, UL 50E, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: Enclosure must be gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (UL 50E Type 1).
- C. Conduit Entry: UL 50E Types 4, 4X, and 12 enclosures may not contain knockouts. UL 50E Types 7 and 9 enclosures must be provided with threaded conduit openings in both endwalls.
- D. Operating Mechanism: Circuit-breaker operating handle must be externally operable with operating mechanism being integral part of box, not cover. Cover interlock mechanism must have externally operated override. Override may not permanently disable interlock mechanism, which must return to locked position once override is released. Tool used to override cover interlock mechanism must not be required to enter enclosure in order to override interlock.
- E. Enclosures designated as UL 50E Type 4, 4X stainless steel, 12, or 12K must have dual cover interlock mechanism to prevent unintentional opening of enclosure cover when circuit breaker is ON and to prevent turning circuit breaker ON when enclosure cover is open.
- F. UL 50E Type 7/9 enclosures must be furnished with breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Commencement of work will indicate Installer's acceptance of areas and conditions as satisfactory.

3.2 SELECTION OF ENCLOSURES

- A. Indoor, Dry and Clean Locations: UL 50E, Type 1.
- B. Outdoor Locations: UL 50E, Type 4X.
- C. Other Wet or Damp, Indoor Locations: UL 50E, Type 4.
- D. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: UL 50E, Type 12.

3.3 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Special Techniques:
 - 1. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
 - 2. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
 - 3. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
 - 4. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
 - 5. Install fuses in fusible devices.

3.4 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.5 FIELD QUALITY CONTROL

- A. Field tests and inspections must be witnessed by Architect, Owner, Construction Manager.
- B. Tests and Inspections for Switches:
 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.
 - f. Verify that each fuse has adequate mechanical support and contact integrity.
 - g. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.
 - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on Drawings.
 - i. Verify correct phase barrier installation.
 - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
 2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
- b. Measure contact resistance across each switchblade fuseholder. Drop values may not exceed high level of manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
- c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, use Table 100.1 from NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
- e. Perform ground fault test in accordance with NETA ATS Section 7.14 "Ground Fault Protection Systems, Low-Voltage."

C. Tests and Inspections for Molded-Case Circuit Breakers:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data are as described in the Specifications and shown on Drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and clearances.
- d. Verify that unit is clean.
- e. Operate circuit breaker to ensure smooth operation.
- f. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.

- g. Inspect operating mechanism, contacts, and chutes in unsealed units.
- h. Perform adjustments for final protective device settings in accordance with coordination study.

2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
- b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, use Table 100.1 from NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- c. Perform contact/pole resistance test. Drop values may not exceed high level of manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
- d. Perform insulation resistance tests on control wiring with respect to ground. Applied potential must be 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable. Test duration must be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values may be no less than 2 M Ω .
- e. Determine the following by primary current injection:
 - 1) Long-time pickup and delay. Pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 2) Short-time pickup and delay. Short-time pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 3) Ground-fault pickup and time delay. Ground-fault pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 4) Instantaneous pickup. Instantaneous pickup values must be as specified and within manufacturer's published tolerances.
- f. Test functionality of trip unit by means of primary current injection. Pickup values and trip characteristics must be as specified and within manufacturer's published tolerances.
- g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of shunt trip and close coils must be as indicated by manufacturer.

- h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset trip logs and indicators. Investigate units that do not function as designed.
 - i. Verify operation of charging mechanism. Investigate units that do not function as designed.
 - 3. Test and adjust controls, remote monitoring, and safeties.
 - D. Nonconforming Work:
 - 1. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
 - E. Collect, assemble, and submit test and inspection reports.
 - 1. Test procedures used.
 - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
 - 3. List deficiencies detected, remedial action taken, and observations after remedial action.
 - F. Manufacturer Services:
 - 1. Engage factory-authorized service representative to support field tests and inspections.
- 3.6 ADJUSTING
- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- 3.7 PROTECTION
- A. After installation, protect enclosed switches and circuit breakers from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.
- 3.8 MAINTENANCE
- A. Infrared Scanning of Enclosed Switches and Breakers: Two months after Substantial Completion, perform infrared scan of joints and connections. Remove covers so joints and connections are accessible to portable scanner. Take visible light photographs at same locations and orientations as infrared scans for documentation to ensure follow-on scans match same conditions for valid comparison.

1. Instruments and Equipment: Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
2. Follow-up Infrared Scanning: Perform two follow-up infrared scans of enclosed switches and breakers, one at four months and another at 11 months after Substantial Completion.
3. Instrument: Use infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide documentation of device calibration.
4. Report: Prepare certified report that identifies units checked and that describes scanning results. Include notation of deficiencies detected, remedial actions taken, and scanning observations after remedial action.

END OF SECTION 262816

SECTION 265000 - LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Luminaires.
2. Luminaire fittings.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" specifies additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" specifies seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" specifies wiring connections installed by this Section.
4. Section 260529 "Hangers and Supports for Electrical Systems" specifies channel and angle supports installed by this Section.
5. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs installed by this Section.
6. Section 260923 "Lighting Control Devices" specifies automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors installed by this Section.

1.2 DEFINITIONS

- A. BUG Rating:** Backlight, uplight, and glare rating for light pollution from exterior luminaires.
- B. CMH:** Ceramic metal halide.
- C. Correlated Color Temperature (CCT):** The absolute temperature (in kelvins) of a blackbody whose chromaticity (color quality) most nearly resembles that of the light source.
- D. Color Rendering Index (CRI):** The measure of the degree of color shift objects undergo when illuminated by the light source as compared with the color of those same objects when illuminated by a reference light source. The lower the CRI of a light source, the more difficult it is to identify colors and stripes on electronic components and wiring.

E. HPS: High-pressure sodium.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For luminaires.

a. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.

- 1) If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.
- 2) Listing criteria identified in approval letter must match specified listing criteria. Approval of only equipment's enclosure is not considered approval of equipment for intended application.
- 3) Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for similar products are not acceptable.

b. Product Certificates: Include product certificates stating compliance with standards listed below, signed by manufacturer or fabricator.

- 1) Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with current accreditation under National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

c. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

d. Include operating characteristics, electrical characteristics, and furnished accessories.

e. Include schedule of submitted lighting products. Arrange schedule and accompanying product data in order by luminaire and lamp designations indicated on Drawings.

f. Include battery and charger data for emergency lighting units.

g. Include ballast factor.

h. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.

i. Include photometric data and adjustment factors obtained from qualified laboratory tests.

2. For luminaire fittings.

a. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.

- 1) If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.
 - 2) Listing criteria identified in approval letter must match specified listing criteria. Approval of only equipment's enclosure is not considered approval of equipment for intended application.
 - 3) Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for similar products are not acceptable.
- b. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - c. Include operating characteristics, electrical characteristics, and furnished accessories.
 - d. Include schedule of submitted lighting products. Arrange schedule and accompanying product data in order by luminaire and lamp designations indicated on Drawings.
3. For electric-discharge lamp control equipment.
- a. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.
 - 1) If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.
 - 2) Listing criteria identified in approval letter must match specified listing criteria. Approval of only equipment's enclosure is not considered approval of equipment for intended application.
 - 3) Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for similar products are not acceptable.
 - b. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - c. Include operating characteristics, electrical characteristics, and furnished accessories.
 - d. Include schedule of submitted lighting products. Arrange schedule and accompanying product data in order by luminaire and lamp designations indicated on Drawings.
4. For lamps.
- a. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.

- 1) If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.
 - 2) Listing criteria identified in approval letter must match specified listing criteria. Approval of only equipment's enclosure is not considered approval of equipment for intended application.
 - 3) Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for similar products are not acceptable.
- b. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - c. Include operating characteristics, electrical characteristics, and furnished accessories.
 - d. Include schedule of submitted lighting products. Arrange schedule and accompanying product data in order by luminaire and lamp designations indicated on Drawings.
 - e. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
5. For luminaire fittings.
- B. Shop drawings: For non-standard or custom lighting fixtures. Include plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Wiring Diagrams: For power, signal, and control wiring.
 3. Light fixture shop drawings shall be in booklet form with a separate sheet for each fixture, assembled in "luminaire type" alphabetical or numerical order, with proposed fixture, lamp type, and accessories clearly indicated on each sheet. Details indicating compatibility with ceiling grid system are required.
- C. Samples: One complete operating unit for each type of interior light fixture when requested by GJT. Each Sample shall include the following:
1. Lamps and ballasts, installed.
 2. Cords and plugs.
 3. Pendant support system.
- D. Installation instructions.
- E. Substitutions:
1. Substitutions: Under provisions of Division 01. One sample of each proposed light fixture substitution unless the GJT waives requirement.
 2. Printed physical, electrical and photometric data clearly highlighted to show the differences between the proposed substitutions and the specified light fixture.
 3. Photometric information in IES standard format on a disc and printed on 8½" x 11" pages.
 4. Point to point lighting calculation for all typical spaces.

- F. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Lighting fixtures.
 - 2. Suspended ceiling components.
 - 3. Partitions and millwork that penetrate the ceiling or extends to within 12 inches (305 mm) of the plane of the luminaires.
 - 4. Ceiling-mounted projectors.
 - 5. Structural members to which suspension systems for lighting fixtures will be attached.
 - 6. Other items in finished ceiling including the following:
 - a. Air outlets and inlets.
 - b. Speakers.
 - c. Sprinklers.
 - d. Smoke and fire detectors.
 - e. Occupancy sensors.
 - f. Access panels.
 - 7. Perimeter moldings.
- B. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.
- C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.
- D. Field quality-control reports.
- E. Maintenance Data: Maintenance data and parts lists for each interior lighting fixture and accessory; including "trouble-shooting" maintenance guide. All data, product data and shop drawings shall be included in a maintenance manual.

- F. Warranty: Sample of special warranty.
- G. Manufacturers' published instructions.
- H. Field Reports:
 - 1. Manufacturer's field reports for field quality-control support.
 - 2. Manufacturer's field reports for system startup support.

1.5 CLOSEOUT SUBMITTALS

- A. Warranty documentation.
- B. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.
- C. Torque Values: Submit torque values for all connections with a torque schedule and witness signature.
- D. As-Built Plans: Submit complete as-built plans of all Work, including interface with other Work, in accordance with requirements as specified in Section 013300 "Submittal Procedures".

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare parts.
- B. Extra stock material.
 - 1. Ballasts/Drivers: One for every 100 of each type and rating installed. Furnish at least one of each type.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect exposed surface finishes on lighting equipment by applying strippable, temporary protective covering before shipping.

1.8 WARRANTY FOR LUMINAIRES

- A. Special Installer Extended Warranty: Installer warrants that fabricated and installed luminaires perform in accordance with specified requirements and agrees to repair or replace products that fail to perform as specified within extended-warranty period. Warranty must convey to Owner upon acceptance of the Work.
 - 1. Extended-Warranty Period: Two years from date of Substantial Completion; full coverage for labor, materials, and equipment.

- B. Special Manufacturer Extended Warranty: Manufacturer warrants that luminaires perform in accordance with specified requirements and agrees to provide repair or replacement of products that fail to perform as specified within extended-warranty period.
 - 1. Extended-Warranty Period: Five years from date of Substantial Completion; prorated coverage for labor, materials, and equipment.

1.9 WARRANTY FOR BATTERIES

- A. Special Manufacturer Extended Warranty for Batteries: Manufacturer warrants that batteries perform in accordance with specified requirements and agrees to provide repair or replacement of batteries that fail to perform as specified within extended-warranty period.
 - 1. Initial Extended-Warranty Period for Li-ion Batteries: Three years from date of Substantial Completion; full coverage for materials only, free on board origin, freight prepaid.
 - 2. Follow-On Extended-Warranty Period for Li-ion Batteries: 10 years from date of Substantial Completion; prorated coverage for materials only, free on board origin, freight prepaid.
 - 3. Initial Extended-Warranty Period for Ni-Cd Batteries: Five years from date of Substantial Completion; full coverage for materials only, free on board origin, freight prepaid.
 - 4. Follow-On Extended-Warranty Period for Ni-Cd Batteries: 15 years from date of Substantial Completion; prorated coverage for materials only, free on board origin, freight prepaid.

1.10 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing & Calculation Guides.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

- E. Comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by the Contract Documents. All equipment furnished under this section shall carry a UL Listing.
- F. FM Global Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- G. Mockups: Provide interior lighting fixtures for room or module mockups, complete with power and control connections.
 - 1. Obtain GJT's approval of fixtures for mockups before starting installations.
 - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.11 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.
- B. The drawings are diagrammatic and indicate the general arrangement of electrical work. Locations are approximate and shall be subject to minor modifications as dictated by field conditions and as directed by GJT.

1.12 WARRANTY

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Emergency Lighting Unit Batteries: Minimum ten (10) years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 1. Products: Subject to compliance with requirements, provide products indicated on drawings.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. General: Lighting fixtures are to be of the sizes, types and ratings required complete with, but not limited to, housings, high power factor ballasts, energy-efficient lamps, lamp holders, reflectors, energy-efficient ballasts, starters, and wiring. Fixtures are to be factory-assembled, with those components required for complete installation. Fixtures with concealed hinges and catches are to have metal parts grounded as a common unit and be constructed to dampen ballast generated noise. Equipment and materials shall bear the UL label.
- B. Environmental Conditions: The equipment shall be designed and constructed to operate successfully at the rated values under the following environmental conditions:
 - 1. Location: Indoors.
 - 2. Altitude 5,500 feet (1677 m) above sea level.
 - 3. Ambient temperature range minus 30 deg F (minus 35 deg C) to 120 deg F (49 deg C), for fixtures in unconditioned locations.
- C. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- D. LED Fixtures: RoHS compliant. Comply with ANSI C78.377 and UL 8750.
- E. Metal Parts: Free of burrs and sharp corners and edges.
- F. Provide all ferrous metal surfaces with a protective finish having rust inhibiting properties. Painted finishes shall be a minimum of 1.5 mils thick and shall have a balance between hardness and bending properties suitable for the application. White finishes shall have 87% minimum reflectance.
- G. Fixtures to be installed in a damp or wet location shall be constructed with proper gasketing and corrosion resistant materials and/or coatings, and have appropriate UL Listing label for wet locations. Construct steel fixture channels, end caps, interior barriers, reflectors, etc. of adequate gauge.
- H. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- I. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- J. Diffusers and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

Minimum unpenetrated thickness shall be 0.35". Polystyrene plastic shall not be permitted. All plastics shall be ETL certified as light stabilized, non-yellowing.

- a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
 - b. UV stabilized.
2. Glass: Annealed crystal glass unless otherwise indicated.
- K. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
- 1. Label shall include the following lamp and ballast characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. CCT and CRI for all luminaires

2.3 DRIVERS FOR SOLID-STATE LAMPS

- A. Description: Listed, electronic, RoHS compliant, meeting the requirements of ANSI C82.77 and UL 8750.
- 1. Dimming: Where required. Meet or exceed specified dimming percentage. Provide 4-wire (0-10V DC Voltage Controlled) dimming drivers which meet the following requirements:
 - a. Compatible with solid-state devices within the range of 1%-100% of the power supply output.
 - b. Meet IEC 60929 Annex E for General White Lighting LED drivers.
 - c. Connect to devices compatible with class 2 0-10V analog control protocol.
 - d. 0-10V control interface shall be completely isolated from the line-voltage AC power supply.
 - e. Available sink current for each driver on the 0-10V interface shall not exceed 1 mA.
 - 2. Rated Life: 50,000 hours minimum. EMERGENCY LED POWER UNIT

2.4 2.04 SOLID-STATE LAMPS

- A. Minimum CRI: 80.
- B. Minimum LED life: 60,000 hours at a lumen output no less than 70% of original output. Lumen maintenance measurements and calculations must conform to IES LM-80 and IES TM-21.
- C. Lumen output shall be as specified on the drawings. Conform to IESNA LM-79.

2.5 LUMINAIRES

- A. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - b. See individual product types below for listing criteria.
 - c. Marked in accordance with UL CCN HYXT, including UL 1598, for compatible power supply, installation location, and environmental conditions.
- B. Source Quality Control:
 - 1. Compile and submit product data.
- C. Refer to the luminaire schedule on the drawings for all products with part numbers for specific fixture information.

2.6 LUMINAIRE FITTINGS

- A. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - b. See individual product types below for listing criteria.
- B. Source Quality Control:
 - 1. Compile and submit product data.
- C. Luminaire Support Accessories:

1. Product Characteristics:
 - a. Sized and rated for luminaire weight.
 - b. Capable of maintaining luminaire position after cleaning and re-lamping.
 - c. Capable of supporting luminaire without causing deflection of ceiling or wall.
 - d. Capable of supporting horizontal force equal to 100 percent of luminaire weight and vertical force equal to 400 percent of luminaire weight.
2. Required Product Options:
 - a. Hook Hangers: Integrated assembly matched to luminaire, supply voltage, and equipment with threaded attachment, cord, and locking-type plug.
 - b. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm) wire supports adjustable to 10 ft (3 m) in length.
 - c. Rod Hangers: 3/16 inch (5 mm) nominal diameter, cadmium-plated, threaded steel rod.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Shop Drawings: Prepare and submit the following:
 1. Drawings, Diagrams, and Supporting Documents for Custom Luminaires:
 - a. Include plans, elevations, sections, and mounting and attachment details.
 - b. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - c. Include diagrams for power, signal, and control wiring.
- B. Temporary Lighting: If approved by Architect, specified luminaires for Project may be installed for temporary lighting. Install and energize minimum quantity of luminaires necessary to meet needs of construction activities. When construction is sufficiently

complete, remove, disassemble, clean, and re-lamp luminaires used for temporary lighting before reinstalling for Project delivery.

3.3 INSTALLATION OF LIGHTING

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
 - 1. Installation of Indoor Lighting Systems: NECA NEIS 500.
 - 2. Installation of Exterior Lighting Systems: NECA NEIS 501.
 - 3. Installation of Industrial Lighting Systems: NECA NEIS 502.
 - 4. Installation of Luminaires, Lampholders, and Lamps: Article 410 of NFPA 70.
 - 5. Installation of Extra-Low-Voltage Lighting: Article 411 of NFPA 70.
 - 6. Installation of Lighting for Sensitive Electronic Equipment: Article 647 of NFPA 70.
 - 7. Installation of Emergency Lighting and Exit Signs: ICC IBC, NFPA 101, and Parts IV and V in Article 700 of NFPA 70.
 - 8. Consult Architect for resolution of conflicting requirements.
- C. Special Installation Techniques:
 - 1. Install luminaires level, plumb, and square with finished floor or grade unless otherwise indicated.
 - 2. Install luminaires at height and aiming angle as indicated on Drawings.
 - 3. Coordinate layout and installation of luminaires with other construction.
 - 4. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
 - 5. Flush-Mounted Luminaire Support:
 - a. Secured to outlet box.
 - b. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - c. Trim ring flush with finished surface.
 - 6. Wall-Mounted Luminaire Support:
 - a. Attached to a minimum 1/8 inch (3 mm) backing plate attached to wall structural members.
 - b. Do not attach luminaires directly to gypsum board.
 - 7. Suspended Luminaire Support:

- a. Ceiling Mount:
 - 1) Hook hangers.
 - 2) Two aircraft cables.
 - b. Pendants and Rods: Where longer than 48 inch (1220 mm), brace to limit swinging.
 - c. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 - d. Continuous Rows of Luminaires: Provide tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
 - e. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
8. Ceiling-Grid-Mounted Luminaire Support:
- a. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each luminaire. Locate not more than 6 inch (150 mm) from luminaire corners.
 - b. Support Clips: Fasten to luminaires and to ceiling grid members at or near each luminaire corner with clips that are UL listed for application.
 - c. Luminaires of Sizes Smaller Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with no fewer than two 3/4 inch (20 mm) metal channels spanning and secured to ceiling tees.
9. Emergency Power Units: Secure with approved fasteners in four or more locations, spaced near corners of unit.
10. Install wiring connections for luminaires.
11. Identification: Provide labels for luminaires and associated electrical equipment.
- a. Identify field-installed conductors, interconnecting wiring, and components.
 - b. Provide warning signs.
 - c. Label each enclosure with engraved metal or laminated-plastic nameplate.
- D. Interfaces with Other Work:
- 1. Coordinate installation of new products with existing conditions.
- E. Systems Integration: Integrate lighting control devices and equipment with electrical power connections for operation of luminaires as specified.

3.4 FIELD QUALITY CONTROL OF LIGHTING

- A. Field tests and inspections must be witnessed by Architect, Construction Manager, and Owner's Representative.

B. Tests and Inspections:

1. Perform manufacturer's recommended tests and inspections.
2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
3. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
4. Verify operation of photoelectric controls.
5. Exterior Illumination Tests:
 - a. Measure light intensities at night. Use photometers with calibration referenced to NIST standards.

C. Nonconforming Work:

1. Luminaire will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

E. Manufacturer Services: Engage factory-authorized service representative to support field tests and inspections.

1. Manufacturer's Field Reports for Field Quality-Control Support: Prepare and submit report after each visit by factory-authorized service representative, documenting activities performed at Project site.

3.5 SYSTEM STARTUP

A. Perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's published instructions.
2. Burn-in lamps that require specific aging period to operate properly, prior to occupancy by Owner.
3. Charge batteries minimum of one hour and depress switch to conduct short-duration test.
4. Charge batteries minimum of 24 hours and conduct one-hour discharge test.

B. Manufacturer Services: Engage factory-authorized service representative to support system startup.

1. Manufacturer's Field Reports for System Startup Support: Prepare and submit report after each visit by factory-authorized service representative, documenting activities performed at Project site.

3.6 ADJUSTING

- A. Luminaire Aiming Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aiming direction of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 2. Parts and supplies must be manufacturer's authorized replacement parts and supplies.
 3. Adjust aim of luminaires in presence of Architect.

3.7 CLOSEOUT ACTIVITIES

- A. Maintenance Material Submittals:
 1. Spare Parts: Furnish to Owner spare parts, for repairing lighting equipment, that are packaged with protective covering for storage on-site and identified with labels describing contents.

3.8 PROTECTION

- A. After installation, protect lighting equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 265000