CONSTRUCTION DOCUMENTS

general construction volume

1

divisions 0 thru 48

Cottonwood Heights Family Change Rooms

7500 SOUTH 2700 EAST I COTTONWOOD HEIGHTS, UTAH

OWNER

Cottonwood Heights Recreation Center
7500 South 2700 East | Cottonwood Heights, Utah

DATE

17 January 2019

PROJECT MANUAL

VCBO ARCHITECTURE
524 South 600 East | Salt Lake City, UT 84102 | 801.575.8800 t | 801.531.9850 f | vcbo.com

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SECTION 00 1116

INVITATION TO BID

PROJECT:	New family change rooms and miscellaneous renovations at the Cottonwood Heights Recreation Center.
LOCATION:	7500 South 2700 East Cottonwood Heights, UT 84121
OWNER:	Cottonwood Heights Parks and Recreation Service Area.
TIME AND PLACE:	Bids will be received from pre-qualified General Contractors only until Tuesday, February 5, 2019 at 3:00 pm MST, at the following location: Cottonwood Heights Recreation Center 7500 South 2700 East Cottonwood Heights, UT 84121 Attn: Ben Hill, Director at which time they will be publicly opened and read aloud.
PRE-QUALIFIED CONTRACTORS:	The Owner has pre-qualified General Contractors for this project; the list will be issued by addendum.
TYPE OF BID:	Bids shall be on a lump sum basis. Alternate bids are also sought. Refer to Section 01 2300 “Alternates” of the Project Manual for descriptions.
TIME OF COMPLETION:	The Owner requires Project Substantial Completion within 75 calendar days following the execution of the Contract for Construction. Contractor must also accommodate opening of outdoor pools at Recreation Center by May 15, 2019. Liquidated damages in the amount of $250 per calendar day will be imposed for failure to bring Project to Substantial Completion by the end of the time period indicated above.
BIDDING DOCUMENTS:	Bidding documents will be available on Friday, January 18, 2019 thru the office of VCBO Architecture, 524 South 600 East, Salt Lake City, Utah 84102 in accordance with the Instructions to Bidders. PDF’s will be given to the invited Contractors.
BONDS:	Bidders shall furnish bid security in the amount of 5 percent of the bid amount, based on the base bid amount and the combination of the highest cost combination of the alternates. The successful bidder shall furnish 100 percent Performance and Payment bonds.

RIGHT TO REJECT BIDS: The Owner reserves the right to reject any or all bids, and to waive any irregularities in any bid or in the bidding. The Owner reserves the right to accept any combination of alternates and to award the contract based on any combination of base bid and alternates which best suits the Owner's needs and available funds

END OF SECTION

SECTION 00 2213

SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

A. AIA A701 "Instructions to Bidders" is hereby incorporated by reference. Copies may be obtained from the Architect for the cost of reproduction.

B. The Supplementary Instructions to Bidders herein describe changes and additions to AIA A701 Instructions to Bidders. Where any part of the Instructions to Bidders is modified by these Supplementary instructions, the unaltered provisions shall remain in effect.

3.1.5 COPIES

Add the following:

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

3.3 SUBSTITUTIONS

Amend 3.3.2 to read:

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

3.4 ADDENDA

Amend 3.4.3 to read:

No addenda will be issued later than 48 hours prior to the date for receipt of Bids. An addenda may be issued no later than 24 hours prior to the date for receipt of bids only for the purpose of postponement or cancellation of receipt of bids. It is the responsibility of the Bidder to disseminate telephone addendum information to sub-bidders.

4.3 SUBMISSION OF BIDS

Amend 4.3.4 to read:

Unless noted in the Invitation to Bid or Advertisement to Bid, facsimile, oral, telephonic or telegraphic Bids are invalid and will not receive consideration.

5.3 ACCEPTANCE OF BID (AWARD)

Amend 5.3.2 to read:

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

7.2 TIME OF DELIVERY AND FORM OF BONDS

Amend 7.2.1 to read:

The Bidder shall deliver the required performance and payment bonds to the Owner within 7 days of Notice of Award. Bonds must be received prior to execution of the Contract.

END OF SECTION

SECTION 00 4113

BID FORM

TO: **COTTONWOOD HEIGHTS RECREATION DISTRICT**
7500 South 2700 East
Cottonwood Heights, Utah 84121

PROJECT: **COTTONWOOD HEIGHTS FAMILY CHANGE ROOMS**
7500 South 2700 East
Cottonwood Heights, Utah 84121

NAME OF BIDDER: _____

DATE: _____

Gentlemen:

The undersigned, in compliance with your invitation for bids, having examined the Drawings and Specifications and related documents and the site of the proposed work and being familiar with all of the conditions surrounding the construction of the proposed project, including the availability of labor, hereby propose to furnish all labor, materials and supplies as required for the Project in accordance with the Contract Documents as specified and within the time set forth and at the price stated below. This price is to cover all expenses incurred in performing the work required under the Contract Documents of which this proposal is a part.

BID BOND:

Enclosed is _____, as required, in the sum of $_____.
(Bond or Check)

BASE BID – Cottonwood Heights Recreation Center Multipurpose Pool

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

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

ALTERNATES

Alternate No. 1: Roofing on Existing Locker Rooms

_____ **Dollars $_____**
Deduct (In the case of discrepancy, written amount shall govern)

COMPLETION DATE:

I/We guarantee to complete the work not later than 75 calendar days following the execution of the Contract for Construction, should I/We be the successful bidder. I/We further agree that work shall accommodate the opening of other outdoor pools at the Recreation Center by May 15, 2019.

This bid shall remain good for 60 days after bid opening.

Liquidated damages will be imposed for each calendar day beyond agreed date of Substantial Completion in the amount of $250.00.

The undersigned Contractor's License Number for Utah is _____.

BONDS:

Upon receipt of notice of acceptance of this bid, the undersigned agrees to execute the contract within five (5) days and deliver Performance and Payment Bond in the prescribed form in the amount of 100% of the general construction contract price for faithful performance of the contract. The certified check, cashier's check or Bid Bond attached, in the amount not less than five percent (5%) of the above bid sum, shall become the property of the OWNER in the event that the contract is not negotiated and/or the Performance and Payment Bond delivered within the time set forth, as liquidated damages for the delay and additional expense caused thereby.

SUBSTITUTIONS:

The following substitutions of materials and/or equipment are proposed:

Item	Manufacturer and Description	Addition	Deduction
	_____	$_____	$_____
	_____	$_____	$_____
	_____	$_____	$_____

ADDENDA:

I/We acknowledge receipt of the following addenda: ___/___/___/___

Type of Organization:

Corporation, Partnership, Individual, etc.) _____

SEAL (If a Corporation)

Respectfully Submitted,

_____
Name of Bidder

_____

_____
Authorized Signature

SECTION 00 5433

AVAILABLE PROJECT INFORMATION

PART 1 - GENERAL

1.1 AGREEMENT CONCERNING DRAWING FILES ON ELECTRONIC MEDIA

A. The electronic files will be distributed from the Architect to the Construction Manager/General Contractor only once the following form has been signed. It will be the General Contractor's responsibility to control distribution.

B. Valentiner Crane Brunjes Onyon Architects, L.L.C. (the Architect) does not assume any responsibility for the accuracy of the information contained in these drawing files. Any and all users are aware that differences may exist between the electronic files delivered and the printed hard-copy construction documents. In the event of a conflict between the signed and sealed hard-copy construction documents prepared by the Architect and the electronic files, the signed or sealed hard-copy construction documents shall govern.

C. Any and all users who may obtain these drawings **from the Construction Manager/General Contractor** under this agreement, including but not limited to, subcontractors, vendors, suppliers etc., agree to indemnify and hold harmless the Architect, its officers, directors, employees and sub-consultants against all damages, liabilities or costs, including reasonable attorneys' fees and defense costs, arising from any changes made by anyone other than the Architect or from any transfer or reuse of the electronic files including data contained in the files without the prior written consent of the Architect.

D. Building Information Model (BIM) drawing files will be made available to the Construction Manager/General Contractor and its subcontractors for the purposes of preparing submittals for their portion of the work **only** after the "Agreement Concerning Drawing Files on Electronic Media" has been signed by the Construction Manager/General Contractor.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION – Not Used

END OF SECTION

AGREEMENT CONCERNING DRAWING FILES ON ELECTRONIC MEDIA

Valentiner Crane Brunjes Onyon Architects, L.L.C. (the Architect) does not assume any responsibility for the accuracy of the information contained in these digital models. Any and all users are aware that differences may exist between the electronic files delivered and the printed hard-copy construction documents. In the event of a conflict between the signed and sealed hard-copy construction documents prepared by the Architect and the electronic files, the signed or sealed hard-copy construction documents shall govern.

Any and all users who may obtain these digital models from the Construction Manager/General Contractor under this agreement, including but not limited to; subcontractors, vendors, suppliers etc., agree to indemnify and hold harmless the Architect, its officers, directors, employees and sub-consultants against all damages, liabilities or costs, including reasonable attorneys' fees and defense costs, arising from any changes made by anyone other than the Architect or from any transfer or reuse of the electronic files without the prior written consent of the Architect.

Under no circumstances shall delivery of the electronic digital models be deemed a sale by the Architect, and the Architect makes no warranties, either express or implied, of merchantability and fitness for any particular purpose. In no event shall the Architect be liable for any loss of profit or any consequential damages as a result of the use or reuse of the electronic files.

The digital Building Information Models provided will contain information as provided on construction documents. The user shall remove all notes, text, detail cuts and member designations from the electronic file prior to use. If used as submittal documents, submittals will be rejected as non-compliant. The drawing files provided by VCBO may not be reproduced or distributed to individuals outside the company or collective organization signing this agreement.

LIST OF DRAWINGS:

Project Name: **Cottonwood Heights Family Change Rooms**
VCBO Project # **16805.01**

List of Revit Models: **Architectural, Structural, Mechanical and Electrical.**

_____

ACCEPTANCE OF TERMS, CONDITIONS & LIMITATIONS:

_____ _____
Name of Company/Contractor Signature of Company/Contractor Representative

_____
Printed Name of Individual Signing

_____ _____
Position/Title Date

This agreement must be signed and returned to VCBO prior to release of any electronic document.

SECTION 00 6276.13

EXEMPTION CERTIFICATE

PART 1 - GENERAL

1.1 SUMMARY

A. Construction materials purchased by or on behalf of the Cottonwood Heights Parks and Recreation Service Area are exempt from Utah sales and use taxes. The appropriate Tax Exempt Form must be used by the vendor when purchasing construction materials for District projects. A copy of the Form which has been completed and signed by the District's Chief Procurement Office or designee follows this cover page.

B. Contractors assume all responsibility for correct use of exemption form and for filing all necessary paperwork with the State of Utah, including all costs associated with audits or other reviews required by the State.

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Utah State Tax Commission

Exemption Certificate for Governments & Schools

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

TC-721G
Rev. 6/11

Name of institution claiming exemption (purchaser)		Telephone Number	
Cottonwood Heights Parks and Recreation Service Area		801-943-3190	
Street Address	City	State	ZIP Code
7500 South 2700 East	Salt Lake City	UT	84121
Authorized Signature	Name (please print)	Title	
Laura Green	Laura Green	Accounts Payable	
Name of Seller or Supplier:		Date	

The person signing this certificate MUST check the applicable box showing the basis for which the exemption is being claimed. Questions should be directed (preferably in writing) to Taxpayer Services, Utah State Tax Commission, 210 N 1950 W, Salt Lake City, UT 84134. Telephone 801-297-2200, or toll free 1-800-662-4335.

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

☐ **UNITED STATES GOVERNMENT OR NATIVE AMERICAN TRIBE**
I certify the tangible personal property or services purchased are to be paid directly with funds from the entity noted on this form and will be used in the exercise of essential governmental or tribal functions. NOTE: Includes sales of tangible personal property to federally chartered credit unions. "Directly" does not include per diem, entity advances, or government reimbursements for employee credit card purchases.

☐ **CONSTRUCTION MATERIALS PURCHASED FOR SCHOOLS OR PUBLIC TRANSIT DISTRICTS**
I certify the construction materials purchased are on behalf of a public elementary or secondary school, or public transit district. I further certify the purchased construction materials will be installed or converted into real property owned by the school or public transit district.
Name of school or public transit district: _____
Name of project: _____

☒ **UTAH STATE AND LOCAL GOVERNMENTS AND PUBLIC ELEMENTARY AND SECONDARY SCHOOLS**
Sales Tax License No. 12269723-002-STC
I certify the tangible personal property or services purchased are to be paid directly with funds from the entity noted on this form and will be used in the exercise of that entity's essential functions. For construction materials, if the purchaser is a Utah state or local government, these construction materials will be installed or converted into real property by employees of this government entity. "Directly" does not include per diem, entity advances, or government reimbursements for employee credit card purchases. **CAUTION:** This exemption does not apply to government or educational entities of other states.

☐ **HEBER VALLEY HISTORIC RAILROAD**
I certify these purchases and sales are by the Heber Valley Historic Railroad Authority or its operators and are related to the operation and maintenance of the Heber Valley Historic Railroad.

☐ **FOREIGN DIPLOMAT**
I certify that lodging-related purchases are authorized by a diplomatic tax exemption card issued by the United States.

FIN 870208592

To be valid this certificate must be filled in completely, including a check mark in the proper box.

A sales tax license number is required only where indicated.

Please sign, date and, if applicable, include your license or exemption number.

NOTE TO SELLER: Keep this certificate on file since it must be available for audit review.

NOTE TO PURCHASER: *Keep a copy of this certificate for your records.* You must notify the seller of cancellation, modification, or limitation of the exemption you have claimed.

If you need an accommodation under the Americans with Disabilities Act, contact the Tax Commission at (801) 297-3811 or TDD (801) 297-2020. Please allow three working days for a response.

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SECTION 00 0700

GENERAL CONDITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. **AIA Document A201 - General Conditions of the Contract for Construction** is hereby incorporated by reference. Copies may be obtained from the Architect for the cost of reproduction.

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SECTION 00 7300

SUPPLEMENTARY GENERAL CONDITIONS

A. The Supplementary Conditions herein described, contain changes and additions to Section 00 7000 - AIA Document A201, 2017 edition, General Conditions of the Contract for Construction. Where any part of the General Conditions is modified by these Supplementary Conditions, the unaltered provisions shall remain in effect.

ARTICLE 1 CONTRACT DOCUMENTS

Add the following:

"1.1.1.1 The Invitation to Bid and Bid Proposal Form shall be part of the Contract Documents."

Add the following:

"1.2.1.2 Where a conflict exists in the Contract Documents, the greater quantity, higher quality, or more restrictive requirement, as determined by the Architect, shall apply."

Add the following:

"1.5.3 Release of Electronic Media Drawing Files: An agreement titled "Agreement Concerning Drawing Files on Electronic Media" must be signed and returned to VCBO Architecture prior to release of any documents. A copy of the release is attached at Section 05 433.

ARTICLE 3 CONTRACTOR

Delete original paragraph 3.7.1 and substitute the following:

"3.7.1 The Contractor shall secure and the Owner shall pay for any permits, fees, and inspections required by work included in this Contract. All licensing shall be secured and paid for by Contractor."

Add the following:

"3.8.4 At close-out of Contract, funds remaining in the Contingency Allowance will be credited to the Owner by Change Order."

Modify the following:

3.10.1 ***Delete*** in the first sentence "... promptly..." and ***substitute*** "... within 24 hours..."

Add at the end of 3.10.1:

"This schedule shall be prepared in accordance with the requirements outlined in **Section 01 3300**, **Submittals** (1.3)."

ARTICLE 5 SUBCONTRACTORS

Modify the following:

5.2.1 ***Delete*** in the first sentence "... as soon as practicable..." and ***substitute*** "... within 24 hours..."

***Delete* 5.2.4** and substitute the following:

"5.2.4 The Contractor shall not change a Subcontractor, person or entity previously selected without written notification and approval of the Owner and Architect."

ARTICLE 7 CHANGES IN THE WORK

Add the following:

“7.1.4 Subcontractors shall be limited to 10 percent mark-up for allowed profit and overhead on proposed changes and modifications. CM/GC shall be limited to 10 percent mark-up for allowed profit and overhead on proposed changes and modifications.”

ARTICLE 8 TIME

Add the following:

"**8.4 Liquidated Damages**

.1 The Contractor and Contractor's Surety shall be liable for and shall pay the Owner the sums hereinafter stipulated as liquidated damages of Two Hundred Fifty Dollars per Day ($250.00) for each calendar day of delay beyond the scheduled completion date until Work is substantially complete. Each trade shall complete their respective work within the General Contractor's construction schedule.

.2 Should the Contractor fail to complete the work within the General Contractor's construction schedule included herein, or within such additional time as may have been allowed by extension, there shall be deducted from any moneys due or that may become due the Contractor the sum as stated in the Agreement. Such sum is fixed and agreed upon by the Owner and the Contractor as liquidated damages due the Owner by reason of the inconvenience and added costs of administration, engineering, and supervision resulting from the Contractor's default, and not as a penalty.

.3 Permitting the Contractor to continue and finish the Work or any part of it after the time fixed for its completion, or after the date to which the time for completion may have been extended, shall in no way operate as a waiver on the part of the Owner of any of his rights under the agreement.

.4 Protection of the top of masonry walls shall be provided as indicated in Division 4 Section “Unit Masonry Assemblies” or a liquidated damage amount of $500.00 per calendar day shall be assessed for each day the top of masonry is not protected."

ARTICLE 9 PAYMENTS AND COMPLETION

Add the following:

“9.3.1.3 Payments made shall be 95 percent of scheduled values requested by each application for payment. Retainage shall be 5 percent and shall be retained until application for final payment is made at the completion of work. Amounts withheld as retainage will be held in an interest bearing account.”

ARTICLE 11 INSURANCE AND BONDS

Add the following:

"11.1.1.1 Insurance limits may be obtained from the Owner.”

Add the following:

“11.1.1.2 The Owner and Architect shall be named as additional insured in the policies required by the Contract Documents.”

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

Add the following;

"12.2.6 Special Project Warranty: Contractor shall warrant the Work of this Contract, in which Contractor agrees to repair or replace all assemblies and components that fail to remain weather-tight, including leaks, including but not limited to, all components of the membrane roofing system, flashings, rooftop mounted accessories or equipment, windows and glazing, doors and frames, storefronts and curtain walls, sealants, exterior wall coverings or claddings, for the following warranty period:
1. Weather-tight Warranty Period: Three years from date of Substantial Completion."

ARTICLE 13 MISCELLANEOUS PROVISIONS

Add the following:

"13.6 INDEMNIFICATION

13.6.1 To the fullest extent permitted by law, Contractor shall indemnify, defend, and hold harmless Owner and Architect and their agents, affiliates, and employees from and against all claims, liabilities, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from the performance of the work, provided that any such claim, liability, damage, loss or expense (1) is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself) including the loss of use resulting therefrom (other than the Work itself or Owner's property), and (2) is caused by whole or in part by an negligent act or omission of Contractor, any Subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or otherwise reduce any other right or obligation of indemnity which would otherwise exist as to any party or person described in this Paragraph 4.18 or in Article 17 hereof.

13.6.2 In any and all claims against Owner or Architect or any of their agents or employees by any employee of Contractor, any Subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, the indemnification obligation under this Paragraph 4.18 shall not be limited in any way by an limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts."

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

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SECTION 01 1000

SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Requirements of Division 0 - Procurement and Contracting Requirements and Division 1 - General Requirements apply to every section contained in the Project Manual, and shall govern the execution of Work required by the Contract Documents.

1.2 SUMMARY

A. Provide everything necessary for and incidental to proper and satisfactory completion of all Work specified and indicated or shown in the Contract Documents.

B. **Project Scope**: Renovations to accommodate two new family changing rooms at Cottonwood Heights Recreation Center.

1.3 PROJECT LOCATION

A. Facility is located at 7500 South 2700 East**,** Cottonwood Heights, Utah.

1.4 SEPARATE CONTRACTS

A. **The Owner may enter into separate contracts for construction**. Each contractor shall be responsible to coordinate efforts with other trade contractors to ensure timely completion of the work.

B. **Coordinate the Work** of this contract with the work of separate contractors to ensure timely completion of the work.

1.5 CODES

A. **Law of place of building governs**. Conform to applicable requirements of the latest editions of the International Building Code, International Mechanical Code, International Plumbing Code, National Electrical Code, National Fire Protection Association requirements, and local ordinances.

B. **Comply** with **CABO/ANSI A117.1**, American National Standard**, "**Accessible and Usable Buildings and Facilities" latest edition which is in force for the project location, for handicapped accessibility.

1.6 CONTRACTOR USE OF PREMISES

A. **General:** During the construction period the Contractor shall have use of the premises for construction operations.
   1. Contractor's use of the premises is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. **Use of the Site**: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.

1. **Driveways and Entrances**: Keep driveways and entrances serving the premises clear and available to Owner and Owner's employees, as well as emergency vehicles at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
2. **Do not unreasonably encumber site** with materials or equipment. Confine stockpiling of materials and location of storage sheds to areas indicated. If additional storage is necessary obtain and pay for such storage off-site.
3. **Lock automotive type vehicles** such as passenger cars and trucks and other types of mechanized and motorized construction equipment, when parked and unattended, so as to prevent unauthorized use. Do not leave such vehicles or equipment unattended with the motor running or the ignition key in place.

1.7 INCIDENTAL WORK

A. **Any work**, materials or equipment that may reasonably be inferred from the Contract Documents as being required to produce the intended result shall be supplied by the Contractor at no additional cost to the Owner whether or not specifically called for in the Contract Documents.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01 1900

DEFINITIONS AND STANDARDS

PART 1 - GENERAL

1.1 SUMMARY

A. **Definitions**: Basic Contract definitions are included in the General Conditions.

1. Directed: Terms such as "directed", "requested", "authorized", "selected", "approved", "required", and "permitted" mean "directed by the Architect", "requested by the Architect", and similar phrases. However, no implied meaning shall be interpreted to extend the Architect's responsibility into the Contractor's area of construction supervision.
2. Approve: The term "approved," where used in conjunction with the Architect's action on the Contractor's submittals, applications, and requests, is limited to the duties and responsibilities of the Architect as stated in General and Supplementary Conditions. Such approval shall not release the Contractor from responsibility to fulfill Contract requirements unless otherwise provided in the Contract Documents.
3. Furnish: The term "furnish" is used to mean "supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations."
4. Install: The term "install" is used to describe operations at project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."
5. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use."

B. **Specification Format and Conventions:**

1. Specification Format: The Specifications are organized into Divisions and Sections using the 50-division format (2004) and CSI/CSC's "MasterFormat" numbering system.
    a. Section Identification: The Specifications use section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete. Consult the Table of Contents at the beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.
2. Specification Content: The Specifications use certain conventions for style of language and the intended meaning of terms, words, and phrases when used in particular situations. These conventions are as follows:
    a. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
    b. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

1) The words “shall”, “shall be”, or “shall comply with”, depending on the context, are implied where a colon (:) is used within a sentence or phrase.

C. **Drawing Symbols**:

1. Graphic symbols: Where not otherwise noted, symbols are defined by "Architectural Graphic Standards", published by John Wiley & Sons, Inc., latest edition.
   a. Mechanical/Electrical Drawings: Graphic symbols used on mechanical and electrical Drawings are generally aligned with symbols recommended by ASHRAE. Where appropriate, they are supplemented by more specific symbols recommended by technical associations including ASME, ASPE, IEEE, and similar organizations. Refer instances of uncertainty to the Architect for clarification before proceeding.

D. **Industry Standards**:

1. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference. Individual Sections indicate which codes and standards the Contractor must keep available at the Project Site for reference.
2. Publication Dates: Where the date of issue of a referenced standard is not specified, comply with the standard in effect as of date of Contract Documents.
3. Conflicting Requirements: Where compliance with two or more standards is specified, and they establish different or conflicting requirements for minimum quantities or quality levels, the most stringent requirement will be enforced, unless the Contract Documents indicate otherwise. Refer requirements that are different, but apparently equal, and uncertainties as to which quality level is more stringent to the Architect for a decision before proceeding.
4. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents.
   a. Where copies of standards are needed for performance of a required construction activity, the Contractor shall obtain copies directly from the publication source.
   b. Although copies of standards needed for enforcement of requirements also may be included as part of required submittals, the Architect reserves the right to require the Contractor to submit additional copies as necessary for enforcement of requirements.

E. **Abbreviations and Names**: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards generating organization, authority having jurisdiction, or other entity applicable to the context of the text provision.

END OF SECTION

SECTION 01 2300

ALTERNATES

PART 1- GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

A. **Alternate**: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

B. **The cost** or **credit** for each alternate is the **net addition to** or **deduction from** the **Contract Sum** to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. **Coordination**: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

B. **Include as part of each alternate**, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

C. **Notification**: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

D. **Execution of Work**: Execute accepted alternates under the same conditions as other work of the Contract.

E. **Schedule**: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. **Alternate No. 1 (Additive) - Roofing Replacement**

1. Base Bid: Infill existing skylights as noted on Drawings and patch existing roof membrane as required. Work shall be accomplished to preserve Owner's existing roof warranty, as applicable.
2. Alternate: Remove existing roofing system as indicated on Drawings and provide new PVC membrane roofing system, including vapor barrier, insulation and membrane. Refer to section 07 5420 "Polyvinyl Chloride (PVC) Roofing".

END OF SECTION

SECTION 01 2600

CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

B. **Related Sections include the following**:
   1. Section 01 6000 "**Product Requirements**" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK

A. **Architect will issue supplemental instructions** authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

A. **Owner-Initiated Proposal Requests**: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
   1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
   2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
      a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
      b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
      c. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. **Contractor-Initiated Proposals**: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to the Architect.
   1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
   2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
   3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
   4. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
   5. Comply with requirements in Division 1 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

C. **Proposal Request Form**: Use AIA Document G709 for Proposal Requests.

1.5 CHANGE ORDER PROCEDURES

A. **On Owner's approval** of a **Proposal Request**, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. **Construction Change Directive**: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
   1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. **Documentation**: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
   1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 2900

PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This **Section specifies** administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. **Related Sections** include the following:
   1. Section 01 2600 "**Contract Modification Procedures**" for administrative procedures for handling changes to the Contract.

1.3 DEFINITIONS

A. **Schedule of Values**: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. **Coordination**: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
   1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
   2. Application for Payment forms with Continuation Sheets.
   3. Submittals Schedule.
   4. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
   5. Sub-schedules: Where the Work is separated into phases requiring separately phased payments, provide sub-schedules showing values correlated with each phase of payment.

B. **Format and Content**: 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.
   1. Identification: Include the following Project identification on the Schedule of Values:
      a. Project name and location.
      b. Name of Architect.
      c. Architect's project number.
      d. Contractor's name and address.
      e. Date of submittal.

2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
    a. Related Specification Section or Division.
    b. Description of the Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.
    f. Change Orders (numbers) that affect value.
    g. Dollar value.
        1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
3. Provide a breakdown of the Contract Sum in enough 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.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
    a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing if required.
6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. 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.
    a. 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.
8. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. **General**: Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
    1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. **Payment Application Times**: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

C. **Payment Application Forms**: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.

D. **Application Preparation**: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
   1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
   2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. **Transmittal**: Submit 3 signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
   1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

F. **Waivers of Mechanic's Lien**: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
   1. Submit partial waivers on each item for amount requested, before deduction for retainage, on each item.
   2. When an application shows completion of an item, submit final or full waivers.
   3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
   4. Waiver Delays: Submit each Application for Payment with Contractor's waiver of mechanic's lien for construction period covered by the application.
      a. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
   5. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.

G. **Initial Application for Payment**: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
   1. List of subcontractors.
   2. Schedule of Values.
   3. Contractor's Construction Schedule (preliminary if not final).
   4. Products list.
   5. Schedule of unit prices.
   6. Submittals Schedule (preliminary if not final).
   7. List of Contractor's staff assignments.
   8. List of Contractor's principal consultants.
   9. Copies of building permits.
   10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
   11. Initial progress report.
   12. Report of preconstruction conference.
   13. Certificates of insurance and insurance policies.
   14. Performance and payment bonds.
   15. Data needed to acquire Owner's insurance.
   16. Initial settlement survey and damage report if required.

H. **Application for Payment at Substantial Completion**: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
   1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
   2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

I. **Final Payment Application**: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
   1. Evidence of completion of Project closeout requirements.
   2. Insurance certificates for products and completed operations where required 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."
   5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
   6. AIA Document G707, "Consent of Surety to Final Payment."
   7. Evidence that claims have been settled.
   8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
   9. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 3100

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This **Section includes administrative provisions for coordinating construction operations** on Project including, but not limited to, the following:
   1. General project coordination procedures.
   2. Conservation.
   3. Coordination Drawings.
   4. Administrative and supervisory personnel.
   5. Project meetings.

B. **Each contractor shall participate in coordination requirements**. Certain areas of responsibility will be assigned to a specific contractor.

C. **Related Sections**:
   1. Section 01 3300 "**Submittals**" for procedures for coordinating electronic submittals.
   2. Section 01 7300 "**Execution Requirements**" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
   3. Section 01 7700 "**Closeout Procedures**" for coordinating Contract closeout.

1.3 COORDINATION

A. **Coordination:** Coordinate construction operations included in various Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.

B. **Memoranda:** If necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
   1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. **Administrative Procedures:** Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's Construction Schedule.
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.

D. **Administrative Software requirements:** Submit all project related information (i.e. Submittals, RFI's, ASI's, Addenda, Construction documents, Project logs, Field reports, and Meeting minutes) using the Architect's File Transfer Site. Architect will provide access information to the General Contractor at the pre-construction meeting or as appropriate to the schedule of the project.
1. Employ a PDF review software system such as Blue Beam (www.bluebeam.com) or another similar system for producing, formatting, and marking-up project related documents. Review all the documents and add their stamp and comments directly to the PDF prior to posting for the Design team to review.
2. Provide to the Architect and Owner, an electronic archive of all data at the end of the project via DVD(s) for final project records.

E. **Contractor is to keep a printed record** of all Construction Documents including all clarifications, RFI's and approved changes to the Contract on site.

F. **Conservation:** Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work.

1.4 SUBMITTALS

A. **Coordination Drawings:** Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
1. Indicate relationship of components shown on separate Shop Drawings.
2. Indicate required installation sequences.
3. Refer to Division 23 Section "Basic Mechanical Materials and Methods" and Division 26 Section "Basic Electrical Materials and Methods" for specific Coordination Drawing requirements for mechanical and electrical installations.

B. **Staff Names: Within 5 business days** of starting construction operations, submit a list of principal staff assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone.

C. **Submittal Log:** See section 'Submittals' for electronic delivery and record keeping.

1.5 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. **General:** In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.
   1. Include special personnel required for coordination of operations with other contractors.
   2. The General Contractor shall have a superintendent on the project whenever Sub-contractors are working on the project.

1.6 PROJECT MEETINGS

A. **General:** Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
   1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
   2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
   3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within 3 days of the meeting.

B. **Preconstruction Conference:** Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
   1. **Attendees**: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; manufacturers; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
   2. **Agenda:** Discuss items of significance that could affect progress, including the following:
      a. Tentative construction schedule.
      b. Phasing.
      c. Critical work sequencing.
      d. Designation of responsible personnel.
      e. Procedures for processing field decisions and Change Orders.
      f. Procedures for processing Applications for Payment.
      g. Distribution of the Contract Documents.
      h. Submittal procedures including access information to the Architect's File Transfer Site.
      i. Preparation of Record Documents.
      j. Use of the premises.
      k. Responsibility for temporary facilities and controls.
      l. Parking availability.
      m. Office, work, and storage areas.
      n. Equipment deliveries and priorities.
      o. First aid.
      p. Security.
      q. Progress cleaning.
      r. Working hours.
   3. **Documentation:** Furnish Architect certificate of insurance naming VCBO as an additional insured.

C. **Progress Meetings:** Conduct progress meetings at weekly intervals. Coordinate dates of meetings with preparation of payment requests.

1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    b. Review present and future needs of each entity present, including the following:
        1) Interface requirements.
        2) Sequence of operations.
        3) Status of submittals.
        4) Deliveries.
        5) Off-site fabrication.
        6) Access.
        7) Site utilization.
        8) Temporary facilities and controls.
        9) Work hours.
        10) Hazards and risks.
        11) Progress cleaning.
        12) Quality and work standards.
        13) Change Orders.
        14) Documentation of information for payment requests.
3. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.
    a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

1.7 REQUESTS FOR INFORMATION (RFI)

A. **Procedure:** Immediately on discovery of the need for interpretation of Contract Document, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.

1. Request shall originate with General Contractor. RFI's submitted by entities other than General Contractor will be returned with no response.
2. Coordinate and submit RFI's in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. **Content of the RFI:** Include a detailed, legible description of item needing interpretation and the following:
   1. Project name.
   2. Date.
   3. Name of Contractor.
   4. Name of Architect and Owner.
   5. RFI number, numbered sequentially.
   6. Specification Section number and title and related paragraphs, as appropriate.
   7. Drawing number and detail references, as appropriate.
   8. Field dimensions and conditions, as appropriate.
   9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contractor Time or the Contract Sum, Contractor shall state impact in the RFI.
   10. Contractor's signature.
   11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
      a. Supplementary drawings prepared by Contractor shall include dimensions, thickness, structural grid references, and details of affected materials, assemblies, and attachments.

C. **Hard-Copy RFI's:** Use the form supplied by the Architect or the Owner.
   1. Identify each page of attachments with the RFI number and sequential page number.
   2. Attachments shall be electronic files in Adobe Acrobat PDF format.

D. **Electronic RFI's:**
   1. RFI's shall be processed and delivered electronically through Architect's File Transfer Site with sequential numbers.

E. **Architect's Action:** Architect will review each RFI, determine action required, and return it. Allow seven working days for Architect's response for each RFI. RFI's received after 1:00 p.m. will be considered as received the following working day.
   1. The following RFI's will be returned without action:
      a. Requests for approval of submittals.
      b. Request for approval of substitutions.
      c. Requests for coordination information already indicated in the Contract Documents.
      d. Request for adjustments in the Contract Time or Contract Sum.
      e. Requests for interpretation of Architect's actions on submittals.
      f. Incomplete RFI's or RFI with numerous errors.
   2. Architect's action may include a request for additional information, in which case Architect's Time for response will start again.
   3. Architect's action on RFI that may result a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
      a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Owner in writing within 10 calendar days of receipt of the RFI response.

F. **On receipt of Architect's and Owner's action**, update the RFI log and immediately distribute the RFI response to the affected parties. Review response and notify Architect and Owner within seven calendar days if Contractor disagrees with response.

G. **RFI Log**: Prepare, maintain, and submit a tabular log of RFI's organized by RFI number. Submit log monthly.
   1. Project name.
   2. Name and address of Contractor.
   3. Name and address of Architect and Owner.
   4. RFI number including RFI's that were dropped and not submitted.
   5. RFI description.
   6. Date the RFI was submitted.
   7. Date Architect's and Owner's response was received.
   8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
   9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 3300

SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This **Section specifies administrative and procedural requirements for submittals** required for performance of the Work, including:
1. Contractor's construction schedule.
2. Daily construction reports.
3. Shop Drawings.
4. Product Data.
5. Samples.
6. Deferred Submittals for review by the Building Code Official.

B. **Administrative Submittals:** Refer to other Division-1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to:
1. Applications for payment.
2. Performance and payment bonds.
3. Insurance certificates.
4. List of Subcontractors.

C. **Inspection and test reports** are included in Division 1 Section "Quality Control Services."

D. **Related Sections:**
1. Section 01 3100 "**Project Management and Coordination**": Electronic web-based construction administration software.

1.3 ELECTRONIC SUBMITTAL DELIVERY

A. **To minimize printing reimbursables**, shipping reimbursables and the impact on the environment, submittals shall be processed and delivered electronically.
1. A single hard copy shall also be furnished, if requested by Architect.

B. **The Construction Manager or Contractor must first review and approve submittals** sent by Subcontractors prior to sending to design team. Include Contractor's certification that information complies with Contract Document requirements, record deviations from Contract Document requirements, including minor variations and limitations. Submittals uploaded by subcontractors shall not be visible to the Design team until the submittal becomes official and is forwarded from the Construction Manager or Contractor to the Design team electronically with a transmittal.

C. **Submittals must follow the requirements outlined** in this specification and as required in individual specification sections.

D. **Deliver following types of submittals** to design team electronically in pdf format:
1. Product Data
2. Shop Drawings
3. Certifications
4. Test Data
5. Schedules
6. Calculations
7. Mix Designs
8. Warranty Information

E. **Samples and Color Selection**
1. Deliver samples/color selections by mail or courier to the design team for review.
2. See separate specification sections for quantities and sample selection process. The design team shall return review comments electronically.

F. **Submittal Stamps**
1. The Contractor or Construction Manager shall affix an electronic stamp to PDF submittals.

G. **Submittal Logs**
1. The design team shall maintain the submittal log through the Architect's internal electronic database system.
2. Construction team shall make a reasonable effort to deliver all submittals electronically. Submittals shall not be delivered by email.
4. Samples shall be logged electronically, but delivered hardcopy.

1.3 SUBMITTAL PROCEDURES

A. **No submittal will be accepted** by the Architect without the General Contractor’s action stamp, clearly visible, indicating that the submittal has been fully reviewed by the General Contractor for compliance to the Construction Documents.

B. **Submittals with** the General Contractor's stamp but not in compliance with the Construction Documents will be deemed incomplete and returned without review. These will not be shown as received.

C. **Coordination:** Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
1. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.
    a. The Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

D. **Processing Time:** Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal.
   1. Initial Review: Allow 15 business days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
   2. Concurrent Review: Where concurrent review of submittals by Architect's consultants, Owner, or other parties is required, allow 20 business days for initial review of each submittal.
   3. Deferred Submittal Review: Where deferred submittals are required by the Building Code Official allow review time as dictated by the Official.
   4. If intermediate submittal is necessary, process it in same manner as initial submittal.
   5. Allow 15 business days for processing each resubmittal.
   6. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.

E. **Submittal Preparation:** Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.
   1. Include the following information on the label for processing and recording action taken.
      a. Project name.
      b. Date.
      c. Name and address of Architect.
      d. Name and address of Contractor.
      e. Name and address of Subcontractor.
      f. Name and address of Supplier.
      g. Name of Manufacturer.

F. **Submittal Transmittal:** Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Architect using a transmittal form. Submittals received from sources other than the Contractor will be returned without action.
   1. On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.

G. **Submittal requirements for electronic PDF submittals:**
   1. All submittals shall be created with native PDF files whenever possible. Do not print a PDF file, and scan in as an image file, as this will delete all file search functions typically embedded within a native PDF file.
   2. All PDF submittals shall be broken down by individual specification section. Do not collate multiple specification sections together into one non-separated submittal package (i.e. carpet, VCT, rubber base, and entry mats; though frequently provided by one installer, shall not be submitted as one non-separated package unless formatted as described below.)

3. All PDF submittals that cover multiple items within one specification section, or PDF submittals that include multiple related specification sections shall have an index and be formatted with electronic book marks to distinguish various components from one another, and make each item easily retrievable without navigating through each page of an entire submittal.
    a. File name shall use VCBO project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., 12005-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 12005-061000.01.A).

1.4 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. **Bar-Chart Schedule:** Prepare a fully developed, horizontal bar-chart type Contractor's construction schedule.
1. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Use the same breakdown of units of the Work as indicated in the "Schedule of Values".
2. Within each time bar indicate estimated completion percentage in 10 percent increments. As Work progresses, place a contrasting mark in each bar to indicate Actual Completion.
3. Prepare the schedule on a sheet of sufficient width to show data for the entire construction period.
4. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the Work. Show each activity in proper sequence. Indicate graphically sequences necessary for completion of related portions of the Work.
5. Coordinate the Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests and other schedules.
6. Indicate completion in advance of the date established for Substantial Completion. Indicate Substantial Completion on the schedule to allow time for the Architect's procedures necessary for certification of Substantial Completion.

B. **Distribution:** Following response to the initial submittal, print and distribute copies to the Architect, Owner, subcontractors, and other parties required to comply with scheduled dates. Post copies in the Project meeting room and temporary field office.
1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

C. **Schedule Updating:** Revise the schedule after each meeting or activity, where revisions have been recognized or made. Issue the updated schedule concurrently with report of each meeting.

1.5 DAILY CONSTRUCTION REPORTS

A. **Daily Construction Report:** Prepare a daily construction report, recording the following information concerning events at the site; and submit duplicate copies to the Architect at weekly intervals:
   1. List of subcontractors at the site.
   2. Approximate count of personnel at the site.
   3. High and low temperatures, general weather conditions.
   4. Accidents and unusual events.
   5. Meetings and significant decisions.
   6. Stoppages, delays, shortages, losses.
   7. Meter readings and similar recordings.
   8. Orders and requests of governing authorities.
   9. Change Orders received, implemented.
   10. Services connected, disconnected.

B. **Material Location Reports:** At monthly intervals, prepare a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.

C. **Field Condition Reports:** Immediately on discovery of a difference between field conditions and the Contract Documents, prepare a detailed report. Submit with a request for information on CSI Form 13.2A. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

1.6 SPECIAL REPORTS

A. **General:** Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. **Reporting Unusual Events:** When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

1.7 SHOP DRAWINGS

A. **Submit in timely manner** to complete project, but no later than 90 days after Notice of Award.
   1. A fee of $100.00 will be charged by the Owner, per submittal for all submittals past this date.

B. **Submit newly prepared information**, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings.

C. **Shop Drawings include** fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Include the following information:
1. Dimensions.
2. Identification of products and materials included.
3. Compliance with specified standards.
4. Notation of coordination requirements.
5. Notation of dimensions established by field measurement.

D. **Sheet Size:** Submit Shop Drawings, layout drawings and other Revit or CADD style sheets formatted for 24 x 36 inch or 30 x 42 inch sheets. Details and drawings are to match or exceed construction bid document scales. All drawings are to be submitted to scale. All other product brochures and cut sheets can be provided in an 8-1/2 x 11 format.

E. **Final Electronic Submittal:** Submit 2 prints, one for the Architect and one for the Owner at the end of the project or as requested by the parties during construction.
1. If submittal was reviewed by members of the design team other than the Architect, provide an additional copy of the submittal for each design firm.
2. The prints shall be marked-up and maintained as a "Record Document".

F. **Final Submittal:** Submit 5 prints. 2 prints will be retained; the remainder will be returned.
1. One of the prints returned shall be marked-up and maintained as a "Record Document".
2. Do not use Shop Drawings without an appropriate final stamp indicating action taken in connection with construction.

1.8 DEFERRED SUBMITTALS/DELEGATED DESIGN SERVICES

A. **Some building elements are specifically required** to be designed under the direction of the supplier or subcontractors. See the General Information sheet on the Drawings for a list of required deferred submittals.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. **All deferred submittals** are to be submitted on same size sheet as original drawings (30 x 42 or 8 1/2 x 11). Drawings and calculations shall be on the title block of the Design Professional engaged by the Contractor; documentation shall include the project name and all other items specified under 'Submittal Preparation' above.
1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

C. **Submit deferred submittals to the Architect** who will disperse three copies to the Building Code Official for review as required by the IBC.

D. Include deferred submittal sheets in the Record Documents.

1.9 PRODUCT DATA

A. **Submit in timely manner** to complete project, but no later than 90 days after Notice of Award.

B. **Collect Product Data** into a single submittal for each element of construction or system. Product Data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as "Shop Drawings."
   1. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information:
      a. Manufacturer's printed recommendations.
      b. Compliance with recognized trade association standards.
      c. Compliance with recognized testing agency standards.
      d. Application of testing agency labels and seals.
      e. Notation of dimensions verified by field measurement.

C. **Do not submit Product Data until** compliance with requirements of the Contract Documents has been confirmed.

D. **Submittals:** Submit one hard copy and one electronic copy of each required submittal; submit additional copies where required for maintenance manuals. The Architect will retain one, and will return the other marked with action taken and corrections or modifications required.

E. **Electronic Submittals:** Submit a pdf copy and a hard copy of each required submittal; include copies where required for maintenance manuals. See electronic submittal delivery and submittal procedures for further requirements

1.10 SAMPLES

A. **Submit in timely manner** to complete project, but no later than 90 days after Notice of Award.

B. **Samples:** Submit full-size, fully fabricated samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture and pattern.

C. **Submittals:** Except for Samples illustrating assembly details, workmanship, fabrication techniques, connections, operation and similar characteristics, submit 3 sets; one will be returned marked with the action taken.
   1. Maintain sets of samples and a file of product submittals, as returned, at the Project site, for quality comparisons and product verification throughout the course of construction.

1.11 CONTRACTOR'S REVIEW

A. **Contractor's Review:** Review each submittal and check for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. **Approval Stamp**: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

C. **Submittals not marked with an approval stamp** and those not in compliance with the Construction Documents shall be returned without further review. It is the Contractor's responsibility to review submittals for compliance prior to forwarding the submittal to the Design Team for review.

1.12 ARCHITECT'S ACTION

A. **Architect's Action:** Except for submittals for record, information or similar purposes, where action and return is required or requested, the Architect will review each submittal, mark to indicate action taken, and return promptly.
   1. Compliance with specified characteristics is the Contractor's responsibility.

B. **Action Stamp:** The Architect will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked to indicate the action taken.
   1. Corrections or comments made on the shop drawings during this review do not relieve the Contractor from compliance with requirements of the drawings and specifications. This check is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. The Contractor is responsible for; confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 4000

QUALITY CONTROL SERVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. **This Section specifies administrative** and **procedural** requirements for quality control services.

B. **Quality control services include inspections** and **tests** and related actions including reports, performed by independent agencies, governing authorities, and the Contractor. They do not include Contract enforcement activities performed by the Architect.

C. **Inspection and testing services are required** to verify compliance with requirements specified or indicated. These services do not relieve the Contractor of responsibility for compliance with Contract Document requirements.
   1. Specific quality control requirements for individual construction activities are specified in the Sections that specify those activities.
   2. Inspections, test and related actions specified are not intended to limit the Contractor's quality control procedures that facilitate compliance with Contract Document requirements.

D. **Requirements for the Contractor** to provide quality control services required by the Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 RESPONSIBILITIES

A. **Contractor Responsibilities**:
   1. Unless otherwise indicated as the responsibility of another identified entity, Contractor shall provide inspections, tests, and other quality-control services specified elsewhere in the Contract Documents and required by authorities having jurisdiction. Costs for these services shall be included in the Contract Sum.
      a. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the Contractor’s responsibility, the Contractor shall employ and pay a qualified independent testing agency to perform quality-control services. Costs for these services are included in the Contract Sum.
      b. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the Owner’s responsibility, the Owner will employ and pay a qualified independent testing agency to perform those services.
   2. Retesting: The Contractor is responsible for retesting where results of required inspections, tests or similar services prove unsatisfactory and do not indicate compliance with Contract Document requirements, regardless of whether the original test was the Contractor's responsibility.

3. Cost of Retesting: Cost of retesting construction revised or replaced by the Contractor is the Contractor's responsibility, where required tests were performed on original construction.
4. Associated Services: The Contractor shall cooperate with agencies performing required inspections, tests and similar services and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include but are not limited to:
    a. Providing access to the Work and furnishing incidental labor and facilities necessary to facilitate inspections and tests.
    b. Taking adequate quantities of representative samples of materials that require testing or assisting the agency in taking samples.
    c. Providing facilities for storage and curing of test samples, and delivery of samples to testing laboratories.
    d. Security and protection of samples and test equipment at the Project site.

B. **Owner Responsibilities**: The Owner will provide inspections, tests and similar quality control services specified to be performed by independent agencies and not by the Contractor, except where they are specifically indicated as the Contractor's responsibility or are provided by another identified entity. Costs for these services are not included in the Contract Sum.
1. The Owner will employ and pay for the services of an independent agency, testing laboratory or other qualified firm to perform services which are the Owner's responsibility.

C. **Duties of the Testing Agency**: The independent testing agency engaged to perform inspections, sampling and testing of materials and construction specified in individual Specification Sections shall cooperate with the Architect and Contractor in performance of its duties, and shall provide qualified personnel to perform required inspections and tests.
1. The agency shall notify the Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. The agency is not authorized to release, revoke, alter or enlarge requirements of the Contract Documents, or approve or accept any portion of the Work.
3. The agency shall not perform any duties of the Contractor.

D. **Coordination**: The Contractor and each agency engaged to perform inspections, tests and similar services shall coordinate the sequence of activities to accommodate required services with a minimum of delay. In addition the Contractor and each agency shall coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
1. The Contractor is responsible for scheduling times for inspections, tests, taking samples and similar activities.

1.3 SUBMITTALS

A. **The independent testing agency** shall submit a certified written report of each inspection, test or similar service, to the Architect, in duplicate
1. Submit additional copies of each written report directly to the governing authority, when the authority so directs.

2. Report Data: Written reports of each inspection, test or similar service shall include, but not be limited to:
    a. Date of issue.
    b. Project title and number.
    c. Name, address and telephone number of testing agency.
    d. Dates and locations of samples and tests or inspections.
    e. Names of individuals making the inspection or test.
    f. Designation of the Work and test method.
    g. Identification of product and Specification Section.
    h. Complete inspection or test data.
    i. Test results and an interpretations of test results.
    j. Ambient conditions at the time of sample-taking and testing.
    k. Name and signature of laboratory inspector.
    l. Recommendations on retesting.

1.4 QUALITY ASSURANCE

A. **Qualification for Service Agencies**: Engage inspection and testing service agencies, including independent testing laboratories, which are prequalified as complying with "Recommended Requirements for Independent Laboratory Qualification" by the American Council of Independent Laboratories, and which specialize in the types of inspections and tests to be performed.
    1. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the State in which the Project is located.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TESTS REQUIRED

A. **Tests required may include** but not be limited to the following (all items listed here may not occur, see Drawings and associated section of the Specifications):
    1. Soil compaction.
    2. Concrete.
    3. Welding.
    4. High strength bolts.
    5. Structural masonry.

3.2 REPAIR AND PROTECTION

A. **General:** Upon completion of inspection, testing, sample-taking and similar services, repair damaged construction and restore substrates and finishes to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes.
    1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 7300 "Execution."

B. **Protect construction exposed by or for** quality control service activities, and protect repaired construction.

C. **Repair and protection is the Contractor's responsibility**, regardless of the assignment of responsibility for inspection, testing or similar services.

END OF SECTION

SECTION 01 5050

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This section **specifies administrative and procedural requirements** for temporary services and facilities, including such items as temporary utility services, temporary construction and support facilities, and project security and protection.

B. **Temporary construction and support facilities** required for the project include but are not limited to the following:
   1. Sanitary facilities, including drinking water.
   2. Hoists.
   3. First aid station.
   4. Waste disposal services.
   5. Construction aids and miscellaneous general services and facilities.

C. **Security and protection facilities** and services required for the project include but are not limited to the following:
   1. Temporary fire protection.
   2. Barricades, warning signs, lights.
   3. Enclosure fence for stored material.
   4. Environmental protection.

1.3 QUALITY ASSURANCE

A. **Regulations**: **Comply with requirements** of local laws and regulations governing construction and local industry standards, in the installation and maintenance of temporary services and facilities, including but not limited to the following:
   1. Building codes, including requirements for permits, testing and inspection.
   2. Health and safety regulations.
   3. Utility company regulations and recommendations governing temporary utility services.
   4. Environmental protection regulations governing use of water and energy, and the control of dust, noise and other nuisances.

B. **Standards**: Comply with the requirements of NFPA Code 241, "Building Construction and Demolition Operations", and ANSI A-10 Series standards for "Safety Requirements for Construction and Demolition", and the NECA National Joint Guideline NJG-6 "Temporary Job Utilities and Services."

C. Refer to the most current "**Guidelines for Bid Conditions for Temporary Job Utilities and Services**", as prepared jointly be AGC and ASC industry recommendations.

1.4 JOB CONDITIONS

A. **General**: Provide each temporary service and facility ready for use at each location when the service or facility is first needed to avoid delay in the performance of the work. Maintain, expand as required and modify temporary services and facilities as needed throughout the progress of the Work. Do not remove until services or facilities are no longer needed, or are replaced by the authorized use of completed permanent facilities.

B. **Conditions of Use**: Operate temporary services and facilities in a safe and efficient manner. 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.
   1. Temporary Construction and Support Facilities: Maintain temporary facilities in such a manner as to prevent discomfort to users. Take necessary fire prevention measures. Maintain temporary support facilities in a sanitary manner so as to avoid health problems and other deleterious effects.
   2. Security and Protection: Maintain site security and protection facilities in a safe, lawful and publicly acceptable manner. Take necessary measures to prevent erosion of the site.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. **General:** Provide new materials and equipment for temporary services and facilities, used materials and equipment that are undamaged and in serviceable condition may be used, if acceptable to the Architect.

B. **Temporary Construction and Support Facilities:** Provide facilities that can be maintained properly throughout their use at the project site.

C. **Temporary Offices and Similar Construction:** For temporary offices, fabrication shops, storage sheds and similar construction, provide either standard prefabricated or mobile units or the equivalent job-built construction.
   1. Self-contained Toilet Units: Provide single-occupant self-contained toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed with a glass fiber reinforced polyester shell or similar non-absorbent material.
   2. Tarpaulins: Provide waterproof, fire-resistant, UL labeled tarpaulins with a flame-spread rating of 15 or less.
   3. First Aid Supplies: Comply with governing regulations and recognized recommendations within the construction industry.
   4. Drinking Water: Provide potable water approved by local health authorities.
   5. Sign Materials: For signs and directory boards, provide exterior type, Grade B-B High Density Concrete Form Overlay Plywood conforming to PS-1, of sizes and thicknesses indicated. Provide exterior grade acrylic-latex-base enamel for painting panels and applying graphics.

D. **Fire Extinguishers**: Provide type "A" fire extinguishers for temporary offices and similar spaces where there is a minimal danger of electrical or grease-oil-flammable liquid fires. In other locations provide type "ABC" dry chemical extinguishers, or a combination of several extinguishers of NFPA recommended types for the exposures in each case.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. **General:** Use qualified tradesmen for installation of temporary services and facilities. Locate temporary services and facilities where they will serve the entire project adequately and result in minimum interference with the performance of the Work.
   1. Relocate, modify and extend services and facilities as required during the course of work so as to accommodate the entire work of the project.

3.2 TEMPORARY CONSTRUCTION AND SUPPORT FACILITIES INSTALLATION

A. **General**: Provide a reasonably neat and uniform appearance in temporary construction and support facilities acceptable to the Architect/Engineer and the Owner.
   1. Locate field offices, storage and fabrication sheds and other support facilities for easy access to the Work. Position offices so that windows give the best possible view of construction activities.
   2. Maintain field offices, storage and fabrication sheds, temporary sanitary facilities, waste collection and disposal systems, and project identification and temporary signs until near substantial completion. Immediately prior to substantial completion remove these facilities.

B. **Sanitary Facilities**: Sanitary facilities include temporary toilets, wash facilities and drinking water fixtures. Comply with governing regulations including safety and health codes for the type, number, location, operation and maintenance of fixtures and facilities; provide not less than specified requirements. Install in locations that will best serve the project's needs.
   1. Sanitary facilities located within the existing facility will not be permitted to be used by the Contractor.

C. **Hoists:** Provide adequate facilities for hoisting materials and employees. Do not permit employees to ride hoists which comply only with requirements for hoisting materials. The Contractor is responsible for selection of type, size, and number of facilities. Truck cranes and similar devices used for hoisting are considered as being "tools and equipment" and not temporary facilities.

D. **Collection and Disposal of Wastes:**
   1. Establish a system for **daily** collection and disposal of waste or extraneous materials from all construction areas on site that may present a hazard to the project, its craftsmen and the expeditious construction of the work. The Contractor shall provide to the Owner a satisfactory method to assure clean-up is performed in a timely and expeditious fashion. Enforce requirements strictly. Do not hold collected materials at the site longer than 1 day. Handle waste materials that are hazardous, dangerous, or unsanitary separately from other inert waste by containerizing appropriately. Dispose of waste material in a lawful manner.
      a. Burying or burning of waste materials on the site will not be permitted.
      b. Washing waste materials down sewers or into waterways will not be permitted.
      c. Provide rodent proof containers located on each floor level of construction work, to encourage depositing of lunch garbage and similar wastes by construction personnel.
   2. The Owner reserves the right to withhold payments and perform the clean-up, if necessary, at the expense of the Contractor, if unsatisfactory clean-up efforts are not performed in a timely fashion.

E. **Construction Aids and Miscellaneous Services and Facilities:**
   1. **Design, construct, and maintain construction aids** and miscellaneous general services and facilities as needed to accommodate performance of the work. Construction aids and miscellaneous general services and facilities include, but or not limited to the following:
      a. Temporary stairs and ladders.
      b. Guardrails and barriers.
   2. **Stairs:** Provide temporary stairs where ladders are not adequate for performance of work.
   3. **Guardrails and Barriers:** Provide guardrails at all unprotected edges of floor and roof openings, and at perimeter of roof and unenclosed floors.

3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. **General:** Provide a reasonably neat and uniform appearance to security and protection facilities acceptable to the Architect/Engineer and the Owner.

B. **Temporary Fire Protection:**

1. Install and maintain temporary fire protection facilities of the types needed to adequately protect against reasonably predictable and controllable fire losses. Comply with applicable recommendations of the NFPA Standard 10 "Standard for Portable Fire Extinguishers". Locate fire extinguishers where they are most convenient and effective for their intended purpose. Store combustible materials in containers in recognized fire-safe locations.
2. Develop and supervise an overall fire prevention and first-aid fire protection program for personnel at the project site. Review needs with the local fire department officials and establish procedures to be followed. Instruct personnel in methods and procedures to be followed. Post warnings and information and enforce strict discipline. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fighting fires. Prohibit smoking of any kind on school property. Provide supervision of welding operations, and similar sources of ignition for possible fires.

C. **Security Enclosure and Lockups:**

1. **Install general temporary enclosure** of partially completed areas of construction. Provide locking entrances adequate to deter unauthorized entrance, vandalism, theft and similar deleterious effects of violations of project security.
2. **Storage:** Where materials and equipment must be temporarily stored, prior to and during construction, and are of substantial value or are attractive for possible theft, provide a secure lockup and enforce strict discipline in connection with the timing of installation and release of materials, so that the opportunity for theft and vandalism is minimized.

D. **General Environmental Protection:** Provide general protection facilities, operate temporary facilities, conduct construction activities, and enforce strict discipline for personnel on the site in ways and by methods that comply with environmental regulations, and that minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result from the performance of work at the site. Avoid the use of tools and equipment which produce harmful noise. Restrict the use of noise making tools and equipment to hours of use that will minimize noise complaints from persons and firms near the project site.

3.4 OPERATION, TERMINATION AND REMOVAL

A. **Supervision:** Enforce strict discipline in use of temporary services and facilities at the site. Limit availability of temporary services and facilities to essential and intended uses to minimize waste and abuse. Do not permit temporary installations to be abused or endangered. Do not allow hazardous, dangerous or unsanitary conditions to develop or persist on the project site.

B. **Maintenance:** Operate and maintain temporary services and facilities in good operating condition throughout the time of use and until removal is authorized. Protect from damage by freezing temperatures and similar elements.

C. **Termination and Removal:** Unless the Architect requests that it be maintained for a longer period of time, remove each temporary service and facility promptly when the need for it or a substantial portion of it has ended, or when is has been replaced by the authorized use of a permanent facility, or no later than substantial completion. Complete, or, if necessary, restore permanent work which may have been delayed because of interference with the temporary service or facility. Repair damaged work, clean exposed surfaces and replace work which cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary services and facilities and remain the property of the Contractor.

END OF SECTION

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SECTION 01 6000

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. **This Section includes** the following administrative and procedural requirements: selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

B. **Related Sections** include the following:
1. Section 01 1900 "**Definitions and Standards**" for applicable industry standards for products specified.
2. Section 01 7700 "**Closeout Procedures**" for submitting warranties for contract closeout.
3. **Divisions 2** through **48 Sections** for specific requirements for **warranties** on products and installations specified to be warranted.

1.3 DEFINITIONS

A. **Products**: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. **Substitutions**: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

C. **Basis-of-Design Product Specification**: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

D. **Manufacturer's Warranty**: Preprinted written warranty published by individual

manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

E. **Special Warranty**: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

1.4 SUBMITTALS

A. **Product List**: Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
   1. Coordination: Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
   2. Form: Tabulate information for each product under the following column headings:
      a. Specification Section number and title.
      b. Generic name used in the Contract Documents.
      c. Proprietary name, model number, and similar designations.
      d. Manufacturer's name and address.
      e. Supplier's name and address.
      f. Installer's name and address.
      g. Projected delivery date or time span of delivery period.
      h. Identification of items that require early submittal approval for scheduled delivery date.
   3. Initial Submittal: Within 30 days after date of commencement of the Work, submit 3 copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.
      a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.
   4. Completed List: Within 60 days after date of commencement of the Work, submit 3 copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
   5. Architect's Action: Architect will respond in writing to Contractor within 15 days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement that products comply with the Contract Documents.

B. **Substitution Requests**: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. Substitution Request Form: Use CSI Form 13.1A or equivalent.
   2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
      a. Statement indicating why specified material or product cannot be provided.
      b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.

      c. Detailed comparison of significant qualities of proposed substitution with

those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
j. Cost information, including a proposal of change, if any, in the Contract Sum.
k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 business days of receipt of request, or 7 business days of receipt of additional information or documentation, whichever is later.
   a. Form of Acceptance: Change Order.
   b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.

C. **Basis-of-Design Product Specification Submittal**: Comply with requirements in **Division 1** Section "**Submittal Procedures**." Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. **Compatibility of Options**: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
   1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
   2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. **Deliver, store, and handle products** using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
   1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
   2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
   3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
   4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
   5. Store products to allow for inspection and measurement of quantity or counting of units.
   6. Store materials in a manner that will not endanger Project structure.
   7. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
   8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
   9. Protect stored products from damage.

1.7 PRODUCT WARRANTIES

A. **General**: Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

B. **Special Warranties**: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
   1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
   2. Refer to Divisions 2 through 48Sections for specific content requirements and particular requirements for submitting special warranties.

C. **Submittal Time**: Comply with requirements in Division 1 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT OPTIONS

A. **General Product Requirements**: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.
   1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
   2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
   3. Owner reserves the right to limit selection to products with warranties not in

conflict with requirements of the Contract Documents.

4. Where products are accompanied by the term "as selected," Architect will make selection.

5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. **Product Selection Procedures**: Procedures for product selection include the following:
1. Product: Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the product named.
   a. Substitutions may be considered, unless otherwise indicated.
2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements.
   a. Substitutions may be considered, unless otherwise indicated.
3. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
   a. Substitutions may be considered, unless otherwise indicated.
4. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
   a. Substitutions may be considered, unless otherwise indicated.
5. Available Products: Where Specification paragraphs or subparagraphs titled "Available Products" introduce a list of names of both products and manufacturers, provide one of the products listed or another product that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
6. Available Manufacturers: Where Specification paragraphs or subparagraphs titled "Available Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed or another manufacturer that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
7. Product Options: Where Specification paragraphs titled "Product Options" indicate that size, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide either the specific product or system indicated or a comparable product or system by another manufacturer. Comply with provisions in "Product Substitutions" Article.
8. Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Products" are included and also introduce or refer to a list of manufacturers' names, provide either the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
   a. Substitutions may be considered, unless otherwise indicated.

9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product (and manufacturer) that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches satisfactorily.
    a. If no product available within specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents on "substitutions" for selection of a matching product.

10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.
    a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
    b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

A. **Timing**: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.

B. **Conditions**: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
    1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
    2. Requested substitution does not require extensive revisions to the Contract Documents.
    3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    4. Substitution request is fully documented and properly submitted.
    5. Requested substitution will not adversely affect Contractor's Construction Schedule.
    6. Requested substitution has received necessary approvals of authorities having jurisdiction.
    7. Requested substitution is compatible with other portions of the Work.
    8. Requested substitution has been coordinated with other portions of the Work.
    9. Requested substitution provides specified warranty.
    10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

3.3 COMPARABLE PRODUCTS

A. **Where products** or manufacturers are **specified by name**, submit the following, in addition to other required submittals, to obtain approval of an unnamed product:
   1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
   2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
   3. Evidence that proposed product provides specified warranty.
   4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
   5. Samples, if requested.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 7300

EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. **This Section includes** general procedural requirements governing **execution of the Work** including, but not limited to, the following:
   1. Construction layout.
   2. Field engineering and surveying.
   3. General installation of products.
   4. Progress cleaning.
   5. Dust control.
   6. Starting and adjusting.
   7. Protection of installed construction.
   8. Correction of the Work.

B. **Related Sections** include the following:
   1. Section 01 3100 "**Project Management and Coordination**" for procedures for coordinating field engineering with other construction activities.
   2. Section 01 3300 "**Submittals**" for administrative submittals and also product and procedural submittals.
   3. Section 01 7700 "**Closeout Procedures**" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3 SUBMITTALS

A. **Landfill Receipts**: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Existing Conditions**: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
   1. Before construction, verify the location and points of connection of utility services.

B. **Existing Utilities**: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
   1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
   2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. **Acceptance of Conditions**: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
   1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
      a. Description of the Work.
      b. List of detrimental conditions, including substrates.
      c. List of unacceptable installation tolerances.
      d. Recommended corrections.
   2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
   3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
   4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
   5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. **Existing Utility Interruptions**: Do not interrupt utilities serving facilities occupied unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Architect and Owner not less than two business days in advance of proposed utility interruptions.

   2. Do not proceed with utility interruptions without Architect's and Owner's written permission.

B. **Field Measurements**: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. **Space Requirements**: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. **Review of Contract Documents and Field Conditions**: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 CONSTRUCTION LAYOUT

A. **Verification**: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

3.4 INSTALLATION

A. **General**: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
   1. Make vertical work plumb and make horizontal work level.
   2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
   3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
   4. Maintain minimum headroom clearance as indicated in spaces without a suspended ceiling.

B. **Comply with manufacturer's written instructions** and recommendations for installing products in applications indicated.

C. **Install products** at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. **Conduct construction operations** so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. **Tools and Equipment**: Do not use tools or equipment that produce harmful noise levels.

F. **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.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
   2. Allow for building movement, including thermal expansion and contraction.

G. **Joints**: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

H. **Hazardous Materials**: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 PROGRESS CLEANING

A. **General**: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
   1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
   2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 degrees F (27 degrees C).
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. **Site**: Maintain Project site free of waste materials and debris.

C. **Work Areas**: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
   1. Remove liquid spills promptly.
   2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. **Installed Work**: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. **Concealed Spaces**: Remove debris from concealed spaces before enclosing the space.

F. **Exposed Surfaces**: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. **Cutting and Patching**: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
   1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

H. **Waste Disposal**: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

I. **Protection**: During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

J. **Maintenance**: Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure smooth operation without damaging effects.

K. **Limiting Exposures**: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.6 DUST CONTROL

A. **Provide continuous** (7 days per week, 24 hours per day) **fugitive dust control measures** within the limits of the construction site, related sites and adjacent streets and roads. Dust control shall be provided for, but not be specifically limited to, the stabilization of unpaved roads, haul roads, access roads, spoil sites, borrow and material sources, excavations, embankments, stockpiles, and all other areas which become potential sources of dust as a result of construction activities.

B. **Maintain compliance with General Utah Air Pollution Regulations**, R446 - Utah Air Conservation Regulations, Section 4.5, Fugitive Emissions, applicable County Air Pollution Control Ordinances, and as directed by the Architect. Dust control measures shall include but not be limited to the following:
   1. Wetting of surfaces with water as appropriate.
   2. Minimizing surface disturbances.

C. **In order to control fugitive dust emissions**, apply following procedures and techniques:
   1. Cover loads of materials, debris and waste materials taken from construction sites as needed to suppress dust during transit.
   2. Water down or apply other approved dust control measures to the construction site, haul roads and public access roads as needed to suppress dust.
   3. All mud and dirt shall be removed from vehicles prior to entering a paved or graveled area or road. Any mud or dirt that is carried out onto paved or graveled surfaces shall be removed from surfaces immediately and no less than daily.

3.7 STARTING AND ADJUSTING

A. **Start equipment** and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. **Adjust operating components** for proper operation without binding. Adjust equipment for proper operation.

C. **Test each piece** of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. **Manufacturer's Field Service**: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

A. **Provide final protection** and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. **Comply with manufacturer's written instructions** for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

A. **Repair or remove** and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section "Cutting and Patching."
   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. **Restore permanent facilities** used during construction to their specified condition.

C. **Remove and replace damaged surfaces** that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. **Repair components** that do not operate properly. Remove and replace operating components that cannot be repaired.

E. **Remove and replace** chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

SECTION 01 7700

CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. **This Section includes** administrative and procedural requirements for contract closeout, including, but not limited to, the following:
   1. Inspection procedures.
   2. Project Record Documents.
   3. Operation and maintenance manuals.
   4. Warranties.
   5. Instruction of Owner's personnel.
   6. Final cleaning.

B. **Related Sections** include the following:
   1. Section 01 2900 "**Payment Procedures**" for requirements for Applications for Payment for Substantial and Final Completion.
   2. Section 01 7300 "**Execution Requirements**" for progress cleaning of Project site.
   3. Section 01 7820 "**Operation and Maintenance Data**" for operation and maintenance manual requirements.
   4. **Divisions 2 through 48** Sections for specific closeout and special cleaning requirements for products of those Sections.

1.3 SUBSTANTIAL COMPLETION

A. **Preliminary Procedures**: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
   1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
   2. Advise Owner of pending insurance changeover requirements.
   3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
   6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
   7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
   8. Complete startup testing of systems.
   9. Submit test/adjust/balance records.

10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Advise Owner of changeover in heat and other utilities.
12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. **Inspection**: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 FINAL COMPLETION

A. **Preliminary Procedures**: Before requesting final inspection for determining date of Final Completion, complete the following:
1. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."
2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report and warranty.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. **Inspection**: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

C. **Additional Review Fees**: Should Architect perform more than one additional review, or extend its construction period services more than 15 business days beyond the scheduled completion date, due to the failure of the Contractor's work to comply with the claims of status or completion made by the Contractor, Owner will compensate Architect for such additional/ extended services at the rate of $500.00 per day. The Owner shall then deduct the amount of such compensation from the final payment to the Contractor.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. **Preparation**: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
   1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
   2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
   3. Include the following information at the top of each page:
      a. Project name.
      b. Date.
      c. Name of Architect.
      d. Name of Contractor.
      e. Page number.

1.6 PROJECT RECORD DOCUMENTS

A. **General**: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

B. **Record Drawings**: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.
   1. Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
      a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.
      b. Accurately record information in an understandable drawing technique.
      c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
      d. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.
   2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
   3. Mark important additional information that was either shown schematically or omitted from original Drawings.
   4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.
   5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.

C. **Record Specifications**: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
   3. Note related Change Orders, Record Drawings, and Product Data, where applicable.

D. **Record Product Data**: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
   3. Note related Change Orders, Record Drawings, and Record Specifications, where applicable.

E. **Miscellaneous Record Submittals**: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

1.7 OPERATION AND MAINTENANCE MANUALS

A. **Assemble a complete set of operation and maintenance data** indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:
   1. Operation Data:
      a. Emergency instructions and procedures.
      b. System, subsystem, and equipment descriptions, including operating standards.
      c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
      d. Description of controls and sequence of operations.
      e. Piping diagrams.
   2. Maintenance Data:
      a. Manufacturer's information, including list of spare parts.
      b. Name, address, and telephone number of Installer or supplier.
      c. Maintenance procedures.
      d. Maintenance and service schedules for preventive and routine maintenance.
      e. Maintenance record forms.
      f. Sources of spare parts and maintenance materials.
      g. Copies of maintenance service agreements.
      h. Copies of warranties and bonds.

B. **Organize operation and maintenance manuals** into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

1.8 WARRANTIES

A. **Submittal Time**: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. **Organize warranty documents** into an orderly sequence based on the table of contents of the Project Manual.
1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (115-by-280-mm) paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

C. **Provide additional copies** of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. **Cleaning Agents**: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 DEMONSTRATION AND TRAINING

A. **Instruction**: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
1. Provide instructors experienced in operation and maintenance procedures.
2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
3. Schedule training with Owner, through Architect, with at least seven days' advance notice.
4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.

B. **Program Structure**: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction for the following:
1. System design and operational philosophy.
2. Review of documentation.
3. Operations.
4. Adjustments.
5. Troubleshooting.
6. Maintenance.
7. Repair.

3.2 FINAL CLEANING

A. **General**: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. **Cleaning**: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. **Complete the following** cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
   a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
   b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
   c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
   d. Remove tools, construction equipment, machinery, and surplus material from Project site.
   e. Remove snow and ice to provide safe access to building.
   f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
   g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
   h. Sweep concrete floors broom clean in unoccupied spaces.
   i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
   j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
   k. Remove labels that are not permanent.
   l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
      1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Replace parts subject to unusual operating conditions.
o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
q. Clean ducts, blowers, and coils if units were operated without filters during construction.
r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
s. Leave Project clean and ready for occupancy.

C. **Pest Control**: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.

D. **Cleaning Standards**: Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

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DIVISION 2 – EXISTING CONDITIONS

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SECTION 02 4101

CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This **Section includes procedural requirements** for cutting and patching.

B. **Patch and repair material disturbed** during construction including, but not limited to, walls, floors, ceilings, asphalt, concrete, lawns and landscaping, roofs, etc.

1.3 DEFINITION

A. **Cutting**: Removal of existing construction necessary to permit installation or performance of other Work.

B. **Patching**: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 SUBMITTALS

A. **Cutting and Patching Proposal**: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed.
   1. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

A. **Structural Elements**: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. **Operational Elements**: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety, including but not limited to the following:
   1. Primary operational systems and equipment.
   2. Fire-protection systems.
   3. Communication systems.
   4. Electrical wiring systems.

C. **Miscellaneous Elements**: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
   1. Piping, ductwork, vessels, and equipment.

D. **Visual Requirements**: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
   1. If possible, retain original Installer or fabricator to cut and patch exposed Work. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.

E. **Cutting and Patching Conference**: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.6 WARRANTY

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. **General**: Comply with requirements specified in other Sections of these Specifications.

B. **Existing Materials**: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
   1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Examine surfaces** to be cut and patched and conditions under which cutting and patching are to be performed.
   1. **Compatibility**: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
   2. **Proceed with installation** only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. **Temporary Support**: Provide temporary support of Work to be cut.

B. **Protection**: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. **Adjoining Areas**: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. **Existing Services**: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to minimize interruption of services to occupied areas.

3.3 PERFORMANCE

A. **General**: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
   1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. **Cutting**: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
   1. General: use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. Concrete/Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
   3. Roofing: Work on existing, warranted membrane shall be accomplished only by original installer or by installer authorized by membrane manufacturer.
   4. Patching: Proceed with patching after construction operations requiring cutting are complete.

C. **Patching**: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Patch masonry with masonry units and grout that match as closely as possible the original. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
   1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
   2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

END OF SECTION

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SECTION 02 4119.13

SELECTIVE BUILDING DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. **This Section includes** the following:
1. Demolition and removal of selected building and site elements.
2. Repair procedures for selective demolition operations.

B. **Related Sections** include the following:
1. Section 02 4101 "**Cutting and Patching**" for cutting and patching procedures for selective demolition operations.
2. Section 31 1000 "**Site Clearing**" for site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

A. **Demolish**: Completely remove and legally dispose of off-site.

B. **Existing to Remain or Retain**: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled

C. **Protect**: Except as otherwise defined in greater detail, the term “protect” is used to describe the process of shielding from harm existing fixtures, elements or materials.

D. **Protect and Maintain**: To remove deteriorating corrosion, reapply protective coatings, and install protective measures such as temporary guards; to provide the least degree of intervention.

E. **Remove**: To detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

F. **Remove and Salvage**: To detach items from existing construction and deliver them to Owner ready for reuse.

G. **Remove and Reinstall**: To detach items from existing construction, repair and clean them for reuse, and reinstall them where indicated.

H. **Salvage**: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner. Include fasteners or brackets needed for reattachment elsewhere.

I. **Stabilize**: To apply measures designed to reestablish a weather-resistant enclosure and the structural reinforcement of an item or portion of the building while maintaining the essential form as it exists at present.

J. **Remove**: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

K. **Existing to Remain**: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

A. **Unless otherwise indicated**, demolition waste becomes property of Contractor.

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

1.5 SUBMITTALS

A. **Qualification Data**: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. **Proposed Protection Measures**: Submit informational report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
   1. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings to remain.

C. **Proposed Dust-Control and Noise-Control Measures**: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.

D. **Schedule of Selective Demolition Activities**: Indicate the following:
   1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
   2. Interruption of utility services.
   3. Coordination for shutoff, capping, and continuation of utility services.
   4. Locations of temporary partitions and means of egress.
   5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

E. **Pre-demolition Photographs or Videotape**: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.

1.5 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.

B. **Standards**: Comply with ANSI A10.6 and NFPA 241.

C. **Pre-demolition Conference**: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to building demolition including, but not limited to, the following:
1. Inspect and discuss condition of construction to be demolished.
2. Review structural load limitations of existing structures.
3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review and finalize protection requirements.
5. Review procedures for noise control and dust control.
6. Review procedures for protection of adjacent buildings.
7. Review items to be salvaged and returned to Owner.

1.6 PROJECT CONDITIONS

A. **Buildings immediately adjacent to demolition area may be occupied**. Conduct building demolition so operations of occupied buildings will not be disrupted.
1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
2. Maintain access to existing walkways, fire lanes, exits, and other facilities used by occupants of adjacent buildings.
    a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.

B. **Owner assumes no responsibility for condition of areas** to be selectively demolished.
1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. **Hazardous Materials**: It is not expected that hazardous materials will be encountered in the Work.
1. Hazardous materials will be removed by Owner before start of the Work.
2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

D. **Utility Service**: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
   1. Maintain fire-protection facilities in service during selective demolition operations.

E. **On-site storage or sale** of removed items or materials is **not permitted**.

PART 2 - PRODUCTS

2.1 REPAIR MATERIALS

A. **Use repair materials** identical to existing materials.
   1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
   2. Use materials whose installed performance equals or surpasses that of existing materials.

B. **Comply with material and installation requirements** specified in individual Specification Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Verify** that utilities have been disconnected and capped.

B. **Survey existing conditions** and correlate with requirements indicated to determine extent of selective demolition required.

C. **Inventory and record** the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. **When unanticipated mechanical, electrical, or structural elements** that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

3.2 UTILITY SERVICES

A. **Existing Utilities**: Maintain services indicated to remain and protect them against damage during selective demolition operations.

B. **Utility Interruption**: Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.

C. **Provide at least 72 hours'** notice to Owner if shutdown of service is required during changeover.

D. **Utility Requirements**: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.

E. **Owner will arrange to shut off indicated utilities** when requested by Contractor.

F. **If utility services are required to be removed**, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.

G. **Utility Requirements**: Refer to Division 22 and 26 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.3 PREPARATION

A. **Dangerous Materials**: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.

B. **Site Access and Temporary Controls**: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
2. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
3. Protect existing site improvements, appurtenances, and landscaping to remain.
4. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.

C. **Temporary Facilities**: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
1. **Provide protection** to ensure safe passage of people around selective demolition area.

D. **Temporary Shoring**: Provide and maintain shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.

3.4 POLLUTION CONTROLS

A. **Dust Control**: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.
1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

B. **Disposal**: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

C. **Cleaning**: 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.

3.5 PROTECTION

A. **Existing Facilities**: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.

B. **Existing Utilities**: Maintain utility services to remain and protect from damage during demolition operations.
   1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
   2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.
      a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.

C. **Temporary Protection**: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Division 1 Section "Temporary Facilities and Controls."
   1. Protect adjacent buildings and facilities from damage due to demolition activities.
   2. Protect existing site improvements, appurtenances, and landscaping to remain.
   3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
   4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
   5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
   6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
   7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.

D. **Remove temporary barriers and protections where hazards no longer exist**. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

E. **Existing Items to Remain**: Protect construction indicated to remain against damage and soiling during demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during demolition and cleaned and reinstalled in their original locations after demolition operations are complete

3.6 DEMOLITION BY MECHANICAL MEANS

A. **Proceed with demolition** of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.

B. **Remove debris** from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
   1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.

C. **Salvage**: Items to be salvaged are indicated on Drawings.

D. **Below-Grade Construction**: Demolish foundation walls and other below-grade construction.
   1. Remove below-grade construction, including basements, foundation walls, and footings, completely.

E. **Existing Utilities**: Demolish and remove existing utilities and below-grade utility structures.
   1. Piping: Disconnect piping at unions, flanges, valves, or fittings.
   2. Wiring Ducts: Disassemble into unit lengths and remove plug-in and disconnecting devices.

3.7 SITE RESTORATION

A. **Below-Grade Areas**: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials according to backfill requirements in Division 31 Earthwork.

B. **Site Grading**: Uniformly rough grade area of demolished construction as required to avoid abrupt changes in grade or areas of unstable earth. Provide a smooth transition between adjacent existing grades and new grades where appropriate.

3.8 PATCHING AND REPAIRS

A. **General**: Promptly repair damage to adjacent construction caused by selective demolition operations.

B. **Repairs**: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
   1. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.

C. **Finishes**: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

3.9 DISPOSAL OF DEMOLISHED MATERIALS

A. **General**: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

B. **Burning**: Do not burn demolished materials.

C. **Disposal**: Transport demolished materials off Owner's property and legally dispose of them.

END OF SECTION

DIVISION 3 - CONCRETE

Section 03 3000 Cast-In-Place Concrete

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SECTION 03 3000

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. **Section includes** cast-in-place concrete, formwork, reinforcement, and accessories.
   1. Cast-in-place concrete used structurally including but not limited to:
      a. Slabs on grade, plain and integrally colored.
   2. Formwork.
   3. Reinforcement.
      a. Reinforcing bars.
      b. Steel wire.
   4. Accessories
      a. Underslab vapor barrier.

B. Refer to Part 3.3.C of this Section for specified concrete finishes. No grout cleaned or plastered finishes shall be permitted or accepted.

1.3 SUBMITTALS

A. **Product Data**: Submit data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry-shake finish materials, and others as requested by Architect.

B. **Shop Drawings; Reinforcement**: Submit original shop drawings prepared by a registered Professional Engineer for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, diagrams of bent bars, arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

D. **Architect's review** is for general architectural applications and features only. Design of formwork for structural stability and efficiency is Contractor's responsibility.

E. **Samples**: Submit samples of materials as requested by Architect, including names, sources, and descriptions.

F. **Laboratory Test Reports**: Submit laboratory test reports for concrete materials and mix design test.

G. **Materials Certificates**: Provide materials certificates in lieu of materials laboratory test reports when permitted by Architect. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

H. **Product Data for Special Concrete Floor Finishes:**

1. Submit special concrete finishes manufacturer's specifications, test data and other data required for each type of manufactured material and product indicated.
2. Submit special concrete finishes describing products to be provided, giving manufacturer's name, product name, and product line number for the specified material proposed to be provided under this section.
3. Submit special concrete finishes manufacturer's recommended installation procedures; which when approved by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the work.
4. Submit special concrete finishes technical data sheet giving descriptive data, curing time, and application requirements.
   a. Provide material analysis and generic type.
5. Test Reports: Provide certified test reports, prepared by an independent testing laboratory, confirming compliance with specified performance criteria

1.4 QUALITY ASSURANCE

A. **Codes and Standards**: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:

1. ACI 301 "Specifications for Structural Concrete for Buildings".
2. ACI 318 "Building Code Requirements for Reinforced Concrete".
3. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice".

B. **Testing Agency**: Owner will employ and pay a qualified independent testing agency to perform field quality-control testing services specified in Part 3 of this section. Retesting of materials failing to meet specified requirements shall be done at Contractor’s expense.

1.5 QUALITY ASSURANCE FOR SPECIAL CONCRETE FLOOR FINISHES

A. **Installer Qualifications**:

1. Use an experienced installer and adequate number of skilled workmen who are thoroughly trained and experienced in the necessary craft.
2. The special concrete finish manufacturer for each specified material and process shall certify applicator.
3. Applicator shall be familiar with the specified requirements and the methods needed for proper performance of work of this section

B. **Manufacturer's Certification**: Provide letter of certification from concrete finish manufacturer or specialized applicator stating that Installer is certified applicator of special concrete finishes, and is familiar with proper procedures and installation requirements required by the manufacturer

C. **Stamped Concrete Mockups**:

1. Construct a 10 foot by 10 foot mockup at location selected by Architect.
2. Provide individual mockups for each color and pattern required.
3. Construct mockup using materials, processes, and techniques required for the work, including curing procedures. Incorporate representative control, construction, and expansion joints according to Project requirements. Installer for the work to construct mockup.
4. Notify Architect and Owner a minimum of seven calendar days in advance of the date scheduled for each mockup construction.
5. Obtain the Architect’s and Owner’s acceptance of each mockup prior to commencement of the work.

6. Each mockup to remain until completion of the work to serve as a quality control standard for the work. Provide suitable protections to preclude damage to mockup.
7. Approved mockup may become part of the completed Work if undisturbed at time of Substantial Completion.

D. **Mockup for Special Concrete Floor Finishes:**
1. At location selected by the Architect, prepare mockup 4 by 4 feet for review and approval.
2. Construct mockup using processes and techniques intended for use on permanent work, including curing procedures. Include samples of control, construction, and expansion joints in mockup panels.
3. Obtain written approval of the mockup from Architect before start of work.
5. Retain approved mockup through completion of the work for use as a quality standard for finished work.
6.

E. **Protection**: **NO SATISFACTORY CHEMICAL OR CLEANING PROCEDURE IS AVAILABLE** to remove petroleum stains from concrete surfaces. PREVENTION IS THEREFORE ESSENTIAL
1. Diaper hydraulic powered equipment to avoid staining of concrete.
2. Do no park vehicles on the inside slab. If necessary to complete their scope of work, drop cloths will be placed under vehicles at all times.
3. No pipe cutting machine will be used on the inside floor slab.
4. Steel will not be placed on interior slab to avoid rust staining.
5. Damaged concrete shall be removed to nearest control joint and replaced at Contractor's expense.

E. **Pre-Installation Conference**: Conduct conference at project site to comply with requirements in Division 1 Section "Project Management and Coordination".

F. **Delivery, Storage and Handling:**
1. Deliver materials in original packages and containers, with seal's unbroken, bearing manufacturer labels indicating brand name and directions for storage, mixing with other components, and application.
2. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.
3. Dispense special concrete finish material from factory numbered and sealed containers. Maintain record of container numbers

1.6 PROJECT CONDITIONS

A. **Protection of Footings against Freezing**: Cover completed work at footing level with sufficient temporary or permanent cover as required to protect footings and adjacent subgrade against possibility of freezing; maintain cover for time period as necessary.

B. **Surface Protection**: Protect adjacent finish materials against spatter during concrete placement.

1.7 PROJECT CONDITIONS FOR SPECIAL CONCRETE FLOOR FINISHES

A. **Environmental limitations**:
   1. Comply with manufacturer's written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting topping performance.
   2. Concrete must be cured a minimum of 45 days or as directed by the manufacturer before application of hardening/sealing agent can begin.
   3. Application of hardening/sealing agent shall take place 10 days prior to installation of equipment and substantial completion, thus providing a complete, uninhibited concrete slab for application.

1.7 WARRANTY ON SPECIAL CONCRETE FLOOR FINISHES

A. **Sealer/Hardener:** Manufacturer's and Certified Applicator's Joint Agreement for **Twenty (20) year material warranty** and **Five (5) year labor warranty**.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. **Available Products**: Subject to compliance with requirements of Contract Documents, products which may be incorporated in the Work include, but are not limited to, the following:

B. **Air Entraining Admixture**:
   1. "Air-Mix"; Euclid Chemical Co.
   2. "MB-VR or MB-AE"; BASF/Master Builders.
   3. "Darex AEA" or "Daravair"; W.R. Grace.

C. **Water Reducing Admixture**:
   1. "WRDA Hycol"; W.R. Grace.
   2. "Eucon WR 75"; Euclid Chemical Co.
   3. "Pozzolith Normal"; Master Builders.
   4. "Plastocrete 161"; Sika Chemical Corp.

D. **Super Plasticizer**:
   1. "WRDA 19" or "Daracem"; W.R. Grace.
   2. "Sikament"; Sika Chemical Corp.
   3. "Eucon 37"; Euclid Chemical Co.
   4. "Rheobuild"; Master Builders.

E. **Water Reducing Non Chloride Accelerator**:
   1. "Accelguard 80"; Euclid Chemical Co.
   2. "Pozzolith High Early"; Master Builders.

F. **Water Reducing Non Chloride Retarder**:
   1. **"**Edoco 20006"; Edoco Technical Products.
   2. "Pozzolith Retarder"; Master Builders.
   3. "Eucon Retarder **75**"; Euclid Chemical Co.
   4. "Daratard"; W.R. Grace.

G. **Non-Metallic Grout**:
1. "Set Grout"; Master Builders.
2. "Duragrout"; L & M Const. Chemical Co.
3. "Five Star Grout"; U.S. Grout Corp.
4. “Non Shrink GP Grout” US Spec.

H. **Liquid Curing Compound (verify compatibility with final floor finish system before applying curing compounds to slabs)**:
1. **Interior:**
   a. “L & M Cure R” or “L & M Cure DR”; L & M Construction Chemicals, Inc.
   b. “Kurez VOX” or “Kurez DR”; The Euclid Chemical Co.
   c. “1100 Clear” or “3100 Clear”; W. R. Meadows.
   d. “Maxcure Resin” clear, US Spec.
2. **Exterior**:
   a. “L & M Cure R-2"; L & M Construction Chemicals, Inc.
   b. “1200 White”; W. R. Meadows.
   c. “Maxicure Resin” white, US Spec.

I. **Bonding Compound**:
1. **Polyvinyl Acetate** (Interior Only):
   a. "Euco Weld"; Euclid Chemical Co.
   b. "Weldcrete"; Larsen Products Corp.
   c. “Everweld”; L & M Construction Chemicals, Inc.
   d. “Bondcoat”, US Spec.
2. **Acrylic or Styrene Butadiene**:
   a. "Everbond"; L & M Construction Chemicals.
   b. "Acryl Set”; Master Builders.
   c. "Acryl 60"; Thoro.
   d. "Daraweld C"; W.R. Grace Construction Products Division.
   e. “Acrylcoat” or “Multicoat”, US Spec.

J. **Epoxy Adhesive**:
1. As indicated on Drawings.

K. **Evaporation Control**:
1. “E-Con”; L & M Construction Chemicals, Inc.
2. "Monofilm ER", US Spec.

L. **Leveling and Topping Compound**:
1. ‘Ardex SD-T’ self-drying, self-leveling concrete topping
   a. Primer: ‘Ardex EP 2000 substrate preparation epoxy.
   b. Color: White or gray as selected by Architect.
   c. Design Mix: As recommended by manufacturer’s written instructions.
2. 'Flow-top HD', US Spec
   a. Primer: 'Maxi-bond 2500'

M. **Under Slab Vapor Barrier:** ASTM E 1745, Class A, except with maximum perm rating of 0.02. Include manufacturer's recommended adhesive or pressure-sensitive tape.
1. Basis of Design: Contract Documents are based on products specified below to establish as standard of quality. Other available manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.
   a. Manufacturer: Stego Industries LLC.
   b. Product: Stego Wrap Vapor Barrier (15 mil)

2. Available Manufacturers: Subject to compliance with requirements of Contract Documents, manufacturers with products that may be incorporated into the Work include, but are not limited to, the following:
   a. Raven Industries "Vapor Block 15 mil".
   b. Reef Industries "15 mil Green"
   c. Stego Industries LLC: "Stego Wrap Vapor Barrier"
   d. W.R. Meadows, Inc: "Perminator 15 mil"
3. Properties:
   a. ASTM D 882 - "Test Methods for Tensile Properties of Thin Plastic Sheeting": 79.6 lbf/inch.
   b. ASTM D 1709 - "Test Methods for Impact Resistance of Plastic Film Water Vapor Transmission Rate through Plastic Film and Sheeting Using a Modulated Infrared Sensor": Method B - 2326 grams.
   c. ASTM F 1249 - "Water Vapor Transmission Rate through Plastic Film and Sheeting Using a Modulated Infrared Sensor": 0.0035 WVTR.
   d. ACI 302.2R-06: "Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials".
4. Accessories**:**
   a. Manufacturer's standard sealing and splicing tape, 3-3/4 inches wide; permeance: no greater than 0.03 perms; tensile strength: 17 lbs./inch width; elongation (at break) MD: 1060 percent.
   b. Manufacturer's standard mastic; medium-viscosity, water-based, polymer-modified anionic bituminous/asphalt emulsion. Permeance: no greater than 0.17 perms; tensile strength: 32 psi; elongation (at break) MD: 3860 percent.
   c. Manufacturer's termination bar: Recycled PVC; 1-1/8 inch high, with beveled edge.

2.2 MANUFACTURERS FOR SPECIAL CONCRETE FLOOR FINISHES

A. **Available Products**: Subject to compliance with requirements of Contract Documents, products which may be incorporated into the Work include, but are not limited to, the following:
   1. **Retro-Plate 99**, manufactured by Advanced Floor Products, Inc.
   2. **Consolideck LS** as manufactured by 'Prosoco."

B. **Performance Criteria:**
   1. Abrasion Resistance: ASTM C779 - Up to 400% increase in abrasion resistance.
   2. Impact Strength: ASTM C805 - 21% increase impact strength.
   3. Ultra Violet Light and Water Spray: ASTM G23-81 - No adverse effect to ultra violet and water spray.
   4. Co-efficient of Friction: ASTM 1028 - all levels of finish (up to 800 grit) exceed OSHA and ADA recommendations.
   5. Reflectivity: 30% increase in reflectivity.

C. **Related Materials:**
   1. Neutralizing Agent: Tri-sodium Phosphate.
   2. Water: Potable.

2.3 MATERIALS

A. **Forms**:

1. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.
   a. Overlaid plywood complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid Concrete Form", Class I.
2. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.
3. Forms for Textured Finish Concrete: Units of face design, size, arrangement, and configuration to match Architect's control sample. Provide solid backing and form supports to ensure stability of textured form liners.
4. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.
5. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units which will leave no metal closer than 1-1/2 inch to surface.
   a. Provide ties which, when removed, will leave holes not larger than 1 inch diameter in concrete surface.

B. **Reinforcing Materials**:

1. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
2. Steel Wire: ASTM A 82, plain, cold-drawn steel.
3. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications.
   a. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
   b. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).
4. Weldable Reinforcing Bars: ASTM A 706

C. **Concrete**:

1. Portland Cement: ASTM C 150, Type I, typical unless noted otherwise.
   a. Use one brand of cement throughout project, unless otherwise acceptable to Architect.
   b. Fly Ash: ASTM C 618, Class F.
   c. Normal Weight Aggregates: ASTM C 33, and as herein specified. Provide aggregates from a single source for exposed concrete.
      1) For exterior exposed surfaces, do not use fine or coarse aggregates containing spalling-causing deleterious substances.
      2) Fine Aggregates shall comply with the following gradations:

Sieve	Percent passing
3/8 inch	100
No. 4	95 to 100
No. 16	50 to 85
No. 50	10 to 30
No. 100	2 to 10

3) Coarse Aggregates shall comply with the following gradations:

Sieve	Percent passing
1-1/2 inch	100
3/4 inch	90 to 100
3/8 inch	25 to 55
No. 4	0 to 10
No. 8	0 to 5
No. 200	Not to exceed 1.75 percent by weight in the combined coarse and fine aggregate.

4) Gradation limits: Maximum aggregate size shall not exceed the following requirements.
   (a) 1/5 narrowest dimension between forms.
   (b) 1/3 of depth of slabs.
   (c) 3/4 of minimum clear spacing between reinforcing bars.

d. Water: Potable.

D. **Admixtures**:
1. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
2. Water-Reducing Admixture: ASTM C 494, Type A, and containing not more than 0.1 percent chloride ions.
3. Super Plasticizer: ASTM C 494, Type F or Type G and containing not more than 0.1 percent chloride ions.
4. Water-Reducing, Non-Chloride Accelerator Admixture: ASTM C 494, Type E, and containing not more than 0.1 percent chloride ions.
5. Water-Reducing, Retarding Admixture: ASTM C 494, Type D, and containing not more than 0.1 percent chloride ions.
6. Prohibited Admixtures: Calcium chloride thyocyanates or admixtures containing more than 0.1 percent chloride ions are not permitted.

E. **Color Pigment**: ASTM C 979/C 979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.

F. **Accessories**:
1. **Reglets**: Where resilient or elastomeric sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 26 gage galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.
2. **Non-Shrink Grout**: Grout shall be prepackaged, non-metallic, non-gaseous. It shall conform to ASTM C 1107 Grade B or C at a fluid, flow cone, consistency. Fluid grout shall attain 6500 psi compressive strength in 28 days.
3. **Absorptive Cover**: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.
4. **Moisture-Retaining Cover**: One of the following, complying with ASTM C 171.
   a. Waterproof paper.
   b. Polyethylene film.
   c. Polyethylene-coated burlap.
5. **Liquid Membrane-Forming Curing Compound**: Liquid type membrane-forming curing compound complying with ASTM C 309, Type 1 or 1D Class B for interior and ASTM C 309 Type 2 Class A for exterior.
6. **Bonding Compound**: Polyvinyl Acetate (interior only) shall conform to ASTM C 1059 Type 1. Acrylic or styrene butadiene shall conform to ASTM C 1059 Type II.

7. **Epoxy Adhesive**: ASTM C 881, two component material suitable for use on dry or damp surfaces. Provide material "Type", "Grade", and "Class" to suit project requirements.
8. **Evaporation Control:** Monomolecular film designed to reduce rapid moisture loss during placement, float and finish operation.

2.4 MIXES

A. **Proportioning and Design of Mixes**:
1. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to Architect for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.
2. Submit written reports to Architect and Structural Engineer of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Architect.

B. **Design mixes** to provide normal weight concrete with a W/C ratio as indicated on the structural drawings.

C. **Adjustment to Concrete Mixes**: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in work.

D. **Admixtures**:
1. Use water-reducing admixture or high range water-reducing admixture (super plasticizer) in concrete as required for placement and workability.
2. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 degrees F.
3. Use high-range water-reducing admixture in pumped concrete, concrete for industrial slabs, architectural concrete, parking structure slabs, concrete required to be watertight, and concrete with water/cement ratios below 0.50.
4. Use air-entraining admixture in exterior exposed concrete, unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content as indicated on the structural drawings.
    a. Concrete structures and slabs exposed to freezing and thawing, deicer chemicals, or subjected to hydraulic pressure:
        1) 4.5 percent (moderate exposure); 5.5 percent (severe exposure) 1 1/2 inch maximum aggregate; 4.5 percent (moderate exposure); 6.0 percent (severe exposure) 1 inch maximum aggregate.
        2) 5.0 percent (moderate exposure); 6.0 percent (severe exposure) 3/4 inch maximum aggregate.
        3) 5.5 percent (moderate exposure); 7.0 percent (severe exposure) 1/2 inch maximum aggregate.

    b. Other Concrete (not exposed to freezing, thawing, or hydraulic pressure): 2 percent to 4 percent air.

5. Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions.
6. Water-Cement Ratio: Provide concrete for following conditions with maximum water-cement (W/C) ratios as indicated on the Structural Drawings.
7. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as indicated.
    a. Ramps, slabs, and sloping surfaces: Not more than 3 inches.
    b. Reinforced foundation systems: Not less than 1 inch and not more than 3 inches.
    c. Concrete containing super-plasticizer: Not more than 8 inch after addition of super plasticizer to site-verified 4 inches slump concrete.
    d. Other concrete: Not less than 1 inch nor more than 4 inches.
8. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

E. **Concrete Mixing**:
1. Job-Site Mixing: Mix materials for concrete in appropriate drum type batch machine mixer. For mixers of one cubic yard, or smaller capacity, 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. For mixers of capacity larger than one cubic yard, increase minimum 1-1/2 minutes of mixing time by 15 seconds for each additional cubic yard, or fraction thereof.
    a. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.
2. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified.
3. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required.

PART 3 - EXECUTION

3.1 GENERAL

A. **Coordinate** the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.

B. **Preparation**: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.

C. **Installation Tolerances**:
1. Slabs: Minimum Flatness FF of 30 and Minimum Levelness FL of 25.
2. Slabs to Receive Special Finish: Minimum Flatness FF of 50 and Minimum Levelness FL of 35.
3. Walls: Comply with ACI requirements for horizontal, vertical, and story to story tolerances.

3.2 ERECTION

A. **Forms**: Design, erect, support, brace, and maintain formwork to support vertical and lateral, static, and dynamic loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances complying with ACI 347.

1. Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.
2. Construct forms to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.
3. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
    a. Class A, 1/8 inch for smooth-formed finished surfaces.
4. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
5. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.
6. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
7. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.
8. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Retightening forms and bracing after concrete placement is required to eliminate mortar leaks and maintain proper alignment.
9. Preparation of Form Surfaces:
    a. Clean re-used forms of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition.
    b. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.
    c. Thin form-coating compounds only with thinning agent of type, amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.
    d. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.3 INSTALLATION

A. **Install** underslab **vapor barrier** at **all slab on grade** applications.
1. Install per ASTM E 1643 - "Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs".
2. Seal around all penetrations using tape and mastic. Create “pitch pockets” using mastic when pipe/conduit spacing is too tight to allow tape.
3. Patch and repair any damage to vapor barrier sheet.
4. Seal vapor barrier to foundation wall with termination bar. Install term bar with beveled edge facing wall; fill gap with continuous bead of sealant or mastic, as approved by vapor barrier manufacturer.

B. **Reinforcement**: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.
1. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
2. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.
3. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
4. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.
5. Avoiding cutting or puncturing vapor barrier during reinforcement placement and concreting operations.

B. **Concrete Placement**:
1. Apply temporary protective covering to lower 2 feet of finished walls adjacent to poured floor slabs and similar conditions, and guard against spattering during placement.
2. General: Comply with ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete", and as herein specified.
3. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.
4. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24 inch and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

5. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.
    a. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6 inch into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
    b. Do not vibrate forms or reinforcing steel.
6. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
    a. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
    b. Bring slab surfaces to correct level with straightedge and strike-off. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
    c. Maintain reinforcing in proper position during concrete placement operations.
7. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306.1 and as herein specified.
    a. When air temperature has fallen to or is expected to fall below 40 degrees F (4 degrees C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F (10 degrees C), and not more than 80 degrees F (27 degrees C) at point of placement.
    b. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
    c. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.
8. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
    a. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees F (32 degrees C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.
    b. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
    c. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.
    d. Use water-reducing retarding admixture (Type D) when required by high temperatures, low humidity, or other adverse placing conditions.

C. **Finish**:

1. Rough Form Finish: Formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.
2. Smooth Form Finish: For formed concrete surfaces exposed-to-view, or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or other similar system. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.
    a. Smooth Rubbed Finish: Provide smooth rubbed finish to concrete surfaces, which have received smooth form finish treatment, not later than one day after form removal.
        1) Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.
3. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring 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.

D. **Slab Finishes**:

1. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, Portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated.
    a. After placing slabs, plane surface to tolerances for floor flatness (F) of 15 and floor levelness (F) of 13. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms, or rakes.
2. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated.
    a. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both, Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to tolerances of F 18 - F 15. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

3. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.
    a. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances of F 20 - F 17. Grind smooth surface defects which would telegraph through applied floor covering system.
4. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.
5. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
    a. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
6. Stamped Concrete:
    a. Stamp concrete surfaces according to manufacturer's instructions.
    b. Mat Stamping: While concrete is plastic, accurately align stamp mats in sequence and uniformly press into concrete to produce imprint pattern, texture, and depth of imprint, according to manufacturer's instructions. Remove stamps from concrete immediately.
        1) Stamp edges and surfaces unable to be imprinted with stamp mat with flexible stamping mats.

E. **Finishing for Slabs to Receive Special Concrete Finish:**
1. Finishing should be close to the surface, do not burn and hard trowel or burn the surface finish.
2. Finish equipment for at least the final work should be equipped with pans. Plastic can be used, but care should be exercised not to burn the floor or leave plastic film.
3. Finish equipment should be run in a minimum of three directions (north/south; east/west; northeast/southeast) to prevent waves in the floor.
4. Care should be exercised to prevent "bird baths" and low spots.

F. **Joints**:
1. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Architect.
2. Provide keyways as indicated on Drawings.
3. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, except as otherwise indicated.
4. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

5. Contraction (Control) Joints in Slabs-on-Ground: Construct contraction joints in slabs-on-ground to form panels of patterns as shown. Use saw cuts 1/8 inch x 1/4 slab depth or inserts 1/4 inch wide x 1/4 of slab depth, unless otherwise indicated. Cut construction joints in concrete as soon as possible after concrete can take the weight of cutting machine, in order to allow cracks to occur at the contraction joint.
   a. Form contraction joints by inserting premolded plastic, hardboard or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.
   b. Contraction joints in unexposed floor slabs may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.
6. Embedded Items:
   a. Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.

   b. Install reglets to receive top edge of foundation sheet waterproofing, and to receive thru-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.
   c. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.

G. **Miscellaneous Concrete**:
1. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.
2. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
3. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

3.4 CURING AND PROTECTION

A. **General**: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
1. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.
2. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

B. **Curing Methods**: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.

1. Provide moisture curing by following methods.
    a. Keep concrete surface continuously wet by covering with water.
    b. Continuous water-fog spray.
    c. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4 inch lap over adjacent absorptive covers.
2. Provide moisture-cover curing as follows:
    a. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inch and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Provide curing and sealing compound to exposed interior slabs and to exterior slabs, walks, and curbs, as follows:
    a. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
    b. Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring (such as ceramic or quarry tile, glue-down carpet), painting, and other coatings and finish materials, unless otherwise acceptable to Architect.
4. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.
5. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of appropriate curing method.
6. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise directed.

C. **Curing for Slabs to Receive Special Concrete Finish:**

1. Verify method with the Installer doing the concrete finishing. A chemical cure meeting ACI 309 will require a chemical removal. Use of curing blankets will require chemical cleaning. Minimum cure time per ACI recommendation is 7 days.
2. Water Cure: Use blankets equal to 'UltraCure' as manufactured by 'McTech Group', www.mctechgroup.com.
    a. Clean the surface immediately after the blankets are pulled up using a product equal to 'PreKlean' as manufactured by 'Consolidek'. It is recommended that the 'PreKlean' produce be applied and removed with an auto-scrubber.
    b. Disposal of removed material must comply with federal and local regulations.

3. Chemical Cure: Use of any ACI 309 cure material is acceptable.
    a. Removal of cure must be done chemically with a product equal to 'Consolideck Wax and Cure Remover' as manufactured by 'Prososo'. Material is to be applied to the surface by spray and allowed to dwell on the surface until the cure begins to break down. Run an auto-scrubber soft brushes applying water over the surface with several passes to agitate the cleaner. Remove with vacuum system on the auto-scrubber.
    b. Disposal of removed material must comply with federal and local regulations

3.5 INSTALLATION OF SPECIAL CONCRETE FLOOR FINISH

A. **Examination:**
1. Examine substrates, with certified applicator (installer) present, for conditions affecting performance of Sealer/Hardener Concrete Finish. Correct conditions detrimental to timely and proper work. Do not proceed until unsatisfactory conditions are corrected.
2. Do not begin installation until substrates have been properly prepared and the floor surfaces are free of construction latents and foreign contaminants that will inhibit penetration of Sealer/Hardener and performance.
3. If substrate preparation is the responsibility of another installer, notify Owner's Representative of unsatisfactory preparation before proceeding.

B. **Application of Special Concrete Floor Finish:**
1. Start any of the floor finish applications in presence of manufacturer's technical representative.
2. Apply concrete floor finish in accordance with manufacturer's instructions.
3. Sealing and Hardening of Concrete Surface:
    a. Concrete must be in place a minimum of 45 days or as directed by the manufacturer before application can begin.
    b. Application is to take place at least 10 days prior to installation of equipment or substantial completion.
    c. Only a certified applicator shall apply Hardening/Sealing Agent. Applicable procedures must be followed as recommended by the product manufacturer and as required to match approved test sample.
    d. Achieve waterproofing, hardening, dust-proofing, and abrasion resistance of the surface while imparting a sheen.
    e. Apply special concrete sealer finish in accordance with sealer manufacturer's instructions.

C. **Field Quality Control:**
1. Manufacturer's Field Services: Manufacturer's representative must be available to provide technical assistance and guidance for surface preparation and application of Sealer/Hardener Concrete Finish.
2. Sealer/Hardener Concrete Finish shall be inspected and acceptable to the Architect and the Manufacturer of Sealer/Hardener Concrete Finish. Any area that is found unacceptable shall be repaired by the Certified Applicator as deemed necessary.

D. **Workmanship and Cleaning:**

1. The premises shall be kept clean and free of debris at all times.
2. Touch-up and restore finish where damaged.
3. Remove spilled, splashed or splattered finish material from all surfaces, as required.
4. Do not mar surface finish or item being cleaned. Make necessary repairs to damaged surfaces caused by cleaning operation or installation of Sealer/Hardener Concrete Finish.
5. Remove debris from jobsite**.** Dispose of materials in separate, closed, sealed containers in accordance with local regulations.

E. **Protection:**

1. Protect and prohibit traffic on Sealer/Hardener Concrete finished work according to manufacturer's instructions and recommendations.
2. Refer to Manufacturer for materials used to cover and protect the flooring surfaces. Do not apply any tape to the floor as it will etch concrete surfaces.

3.5 REMOVAL OF FORMS

A. **Formwork not supporting weight of concrete**, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 degrees F (10 degrees C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

B. **Formwork supporting weight of concrete**, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days and until concrete has attained design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

C. **Form facing material** may be removed 4 days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

D. **Re-Use of Forms**:

1. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.
2. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Architect.

3.6 CONCRETE SURFACE REPAIRS

A. **Patching Defective Areas**: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Architect.

1. Cut out honeycomb, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.
2. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
3. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.
4. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
5. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness using a template having required slope.
6. Repair finished unformed surfaces that contain defects which affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.01 inch wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.
7. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.
8. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to Architect.

B. **Repair defective areas**, except random cracks and single holes not exceeding 1 inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

1. Repair isolated random cracks and single holes not over 1 inch in diameter by dry-pack method. Groove top of cracks and cut-out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry pack after bonding compound has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

C. **Perform structural repairs** with prior approval of Architect or Structural Engineer for method and procedure, using specified epoxy adhesive and mortar.

3.7 FIELD QUALITY CONTROL

A. **Sampling and testing** for quality control during placement of concrete may include the following, as directed by Architect.

1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
    a. Slump: As indicated on the Structural Drawings.
    b. Air Content: As indicated on the Structural Drawings.
    c. Concrete Temperature: Test hourly when air temperature is 40 degrees F and below, and when 80 degrees F and above; and each time a set of compression test specimens made.
2. Compression Test Specimen: ASTM C 31; one set of 5 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
3. Compressive Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cubic yards plus additional sets for each 50 cubic yards over and above the first 25 cubic yards of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and two specimens retained in reserve for later testing if required.
    a. When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.
    b. When total quantity of a given class of concrete is less than 50 cubic yards, strength test may be waived by Architect if, in his judgment, adequate evidence of satisfactory strength is provided.
    c. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
    d. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.

B. **Test results will be reported in writing to Architect**, Structural Engineer and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.

C. **Nondestructive Testing**: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

D. **Additional Tests**: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests when unacceptable concrete is verified.

END OF SECTION

DIVISION 4 - MASONRY

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SECTION 04 0120.63

BRICK MASONRY REPAIR

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. Repairing brick masonry, including replacing units.
   2. Removing abandoned anchors.

1.3 DEFINITIONS

A. **Rebuilding (Setting) Mortar**: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.

1.4 PREINSTALLATION MEETINGS

A. **Preinstallation Conference**: Conduct conference at Project site.
   1. Review methods and procedures related to brick masonry repair including, but not limited to, the following:
      a. Materials, material application, sequencing, tolerances, and required clearances.
      b. Coordination with building occupants.

1.5 SEQUENCING AND SCHEDULING

A. **Order sand and gray Portland cement** for colored mortar immediately after approval of mockups. Take delivery of and store at Project site enough quantity to complete Project.

B. **Work Sequence**: Perform brick masonry repair work in the following sequence, which includes work specified in this and other Sections:
   1. Remove plant growth.
   2. Inspect masonry for open mortar joints and point them before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
   3. Remove paint.
   4. Clean masonry.
   5. Rake out mortar from joints surrounding masonry to be replaced and from joints adjacent to masonry repairs along joints.
   6. Repair masonry, including replacing existing masonry with new masonry materials.
   7. Rake out mortar from joints to be repointed.
   8. Point mortar and sealant joints.
   9. After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.

10. Where water repellents are to be used on or near masonry work, delay application of these chemicals until after pointing and cleaning.

1.6 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 recommendations for product application and use. Include test data substantiating that products comply with requirements.

B. **Shop Drawings**:
   1. Include plans, elevations, sections, and locations of replacement masonry units on the structure, showing relation of existing and new or relocated units.
   2. Show provisions for expansion joints or other sealant joints.
   3. Show provisions for flashing, lighting fixtures, conduits, and weep holes as required.

C. **Samples for Initial Selection**: For the following:
   1. Colored Mortar: Submit sets of mortar that will be left exposed in the form of sample mortar strips, 6 inches long by 1/4 inch wide, set in aluminum or plastic channels.
      a. Have each set contain a close color range of at least six Samples of different mixes of colored sands and cements that produce a mortar matching existing, cleaned mortar when cured and dry.
      b. Submit with precise measurements on ingredients, proportions, gradations, and source of colored sands from which each Sample was made.
   2. Sand Types Used for Mortar: Minimum 8 oz. of each in plastic screw-top jars.
   3. Patching Compound: Submit sets of patching compound Samples in the form of plugs (patches in drilled holes) in sample units of masonry representative of the range of masonry colors on the building.
      a. Have each set contain a close color range of at least six Samples of different mixes of patching compound that matches the variations in existing masonry when cured and dry.
   4. Include similar Samples of accessories involving color selection.

D. **Samples for Verification**: For the following:
   1. Each type of brick unit to be used for replacing existing units. Include sets of Samples to show the full range of shape, color, and texture to be expected. For each brick type, provide straps or panels containing at least four bricks. Include multiple straps for brick with a wide range.
   2. Accessories: Each type of accessory and miscellaneous support.

1.7 QUALITY ASSURANCE

A. **Mockups**: Prepare mockups of brick masonry repair to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.
   1. Masonry Repair: Prepare sample areas for each type of masonry repair work performed. If not otherwise indicated, size each mockup not smaller than two adjacent whole units or approximately 48 inches in least dimension. Construct sample areas in locations in existing walls where directed by Architect unless otherwise indicated. Demonstrate quality of materials, workmanship, and blending with existing work. Include the following as a minimum:
      a. Replacement: Four brick units replaced.
      b. Patching: Three small holes as directed for each type of brick indicated to be patched.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. **Deliver masonry units** to Project site strapped together in suitable packs or pallets or in heavy-duty cartons and protected against impact and chipping.

B. **Deliver packaged materials** to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.

C. **Store cementitious materials** on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

D. **Store hydrated lime** in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.

E. **Store sand** where grading and other required characteristics can be maintained and contamination avoided.

F. **Handle masonry units** to prevent overstressing, chipping, defacement, and other damage.

1.9 FIELD CONDITIONS

A. **Weather Limitations**: Proceed with installation only when existing and forecasted weather conditions permit brick masonry repair work to be performed according to product manufacturers' written instructions and specified requirements.

B. **Temperature Limits, General**: Repair masonry units only when air temperature is between 40 and 90 degrees F and is predicted to remain so for at least seven days after completion of the Work unless otherwise indicated.

C. **Cold-Weather Requirements**: Comply with the following procedures for masonry repair unless otherwise indicated:
   1. When air temperature is below 40 degrees F, heat mortar ingredients, masonry repair materials, and existing masonry walls to produce temperatures between 40 and 120 degrees F.
   2. When mean daily air temperature is below 40 degrees F, provide enclosure and heat to maintain temperatures above 32 degrees F within the enclosure for seven days after repair.

D. **Hot-Weather Requirements**: Protect masonry repairs when temperature and humidity conditions produce excessive evaporation of water from mortar and repair materials. Provide artificial shade and wind breaks, and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 degrees F and above unless otherwise indicated.

E. **For manufactured repair materials**, perform work within the environmental limits set by each manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. **Source Limitations**: Obtain each type of material for repairing brick masonry (brick, cement, sand, etc.) from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 MASONRY MATERIALS

A. **Face Brick**: As required to complete brick masonry repair work.
   1. Brick Matching Existing: Units with colors, color variation within units, surface texture, size, and shape that match existing brickwork and with comparable physical properties.
      a. For existing brickwork that exhibits a range of colors or color variation within units, provide brick that proportionally matches that range and variation rather than brick that matches an individual color within that range.
   2. Special Shapes:
      a. Provide molded, 100 percent solid shapes for applications where core holes or "frogs" could be exposed to view or weather when in final position and where shapes produced by sawing would result in sawed surfaces being exposed to view.
      b. Mechanical chopping or breaking brick, or bonding pieces of brick together by adhesive, are unacceptable procedures for fabricating special shapes.
   3. Tolerances as Fabricated: According to tolerance requirements in ASTM C 216, Type FBX.

2.3 MORTAR MATERIALS

A. **Portland Cement**: ASTM C 150, Type I or Type II, except Type III may be used for cold-weather construction; white or gray, or both where required for color matching of mortar.
   1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

B. **Hydrated Lime**: ASTM C 207, Type S.

C. **Masonry Cement**: ASTM C 91.

D. **Mortar Cement**: ASTM C 1329.

E. **Mortar Sand**: ASTM C 144.
   1. Exposed Mortar: Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.

F. **Mortar Pigments**: ASTM C 979, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

G. **Water: Potable**.

2.4 MANUFACTURED REPAIR MATERIALS

A. **Brick Patching Compound**: Factory-mixed cementitious product that is custom manufactured for patching brick masonry.
   1. Use formulation that is vapor and water permeable (equal to or more than the masonry unit), exhibits low shrinkage, has lower modulus of elasticity than masonry units being repaired, and develops high bond strength to all types of masonry.
   2. Use formulation having working qualities and retardation control to permit forming and sculpturing where necessary.
   3. Formulate patching compound in colors and textures to match each masonry unit being patched. Provide sufficient number of colors to enable matching of the color, texture, and variation of each unit.

2.5 ACCESSORY MATERIALS

A. **Setting Buttons and Shims**: Resilient plastic, nonstaining to masonry, sized to suit joint thicknesses and bed depths of masonry units, less the required depth of pointing materials unless removed before pointing.

B. **Masking Tape**: Nonstaining, nonabsorbent material; compatible with mortar, joint primers, sealants, and surfaces adjacent to joints; and that easily comes off entirely, including adhesive.

C. **Other Products**: Select materials and methods of use based on the following, subject to approval of a mockup:
   1. Previous effectiveness in performing the work involved.
   2. Minimal possibility of damaging exposed surfaces.
   3. Consistency of each application.
   4. Uniformity of the resulting overall appearance.
   5. Do not use products or tools that could leave residue on surfaces.

2.6 MORTAR MIXES

A. **Measurement and Mixing**: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

B. **Colored Mortar**: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.
   1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

C. **Do not use admixtures** in mortar unless otherwise indicated.

D. **Mixes**: Mix mortar materials in the following proportions:
   1. Rebuilding (Setting) Mortar by Type: ASTM C 270, Proportion Specification, Type S unless otherwise indicated; with cementitious material limited to Portland cement and lime, masonry cement, or mortar cement.
   2. Pigmented, Colored Mortar: Add mortar pigments to produce exposed, setting (rebuilding) mortar of colors required.

PART 3 - EXECUTION

3.1 PROTECTION

A. **Prevent mortar from staining face** of surrounding masonry and other surfaces.
   1. Cover sills, ledges, and other projecting items to protect them from mortar droppings.
   2. Keep wall area wet below rebuilding and repair work to discourage mortar from adhering.
   3. Immediately remove mortar splatters in contact with exposed masonry and other surfaces.

B. **Remove downspouts and associated hardware** adjacent to masonry and store during masonry repair. Reinstall when repairs are complete.
   1. Provide temporary rain drainage during work to direct water away from building.

3.2 MASONRY REPAIR, GENERAL

A. **Appearance Standard**: Repaired surfaces are to have a uniform appearance as viewed from 10 feet away by Architect.

3.3 ABANDONED ANCHOR REMOVAL

A. **Remove abandoned anchors, brackets, wood nailers, and other extraneous items** no longer in use unless indicated to remain.
   1. Remove items carefully to avoid spalling or cracking masonry.
   2. Notify Architect before proceeding if an item cannot be removed without damaging surrounding masonry. Do the following where directed:
      a. Cut or grind off item approximately 3/4 inch beneath surface and core drill a recess of same depth in surrounding masonry as close around item as practical.
      b. Immediately paint exposed end of item with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended dry film thickness per coat. Keep paint off sides of recess.
   3. Patch hole where each item was removed unless directed to remove and replace masonry unit.

3.4 BRICK REMOVAL AND REPLACEMENT

A. **At locations indicated**, remove bricks that are damaged, spalled or deteriorated, or are to be reused. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.
   1. When removing single bricks, remove material from center of brick and work toward outside edges.

B. **Support and protect remaining masonry** that surrounds removal area.

C. **Maintain flashing**, reinforcement, lintels, and adjoining construction in an undamaged condition. Coordinate with new flashing, reinforcement, and lintels, which are specified in other Sections.

D. **Notify Architect** of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.

E. **Remove in an undamaged condition as many whole bricks as possible**.
   1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
   2. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.
   3. Store brick for reuse. Store off ground, on skids, and protected from weather.
   4. Deliver cleaned brick not required for reuse to Owner unless otherwise indicated.

F. **Clean masonry surrounding removal areas** by removing mortar, dust, and loose particles in preparation for brick replacement.

G. **Replace removed damaged brick** with other removed brick in good condition, where possible, or with new brick matching existing brick. Do not use broken units unless they can be cut to usable size.

H. **Install replacement brick** into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.
   1. Maintain joint width for replacement units to match existing joints.
   2. Use setting buttons or shims to set units accurately spaced with uniform joints.

I. **Lay replacement brick with rebuilding (setting) mortar** and with completely filled bed, head, and collar joints. Butter ends with enough mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C 67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min. Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.
   1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.
   2. When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.

J. **Curing**: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
   1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.5 FINAL CLEANING

A. **After mortar has fully hardened**, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water applied by low-pressure spray.
   1. Do not use metal scrapers or brushes.
   2. Do not use acidic or alkaline cleaners.

B. **Clean adjacent nonmasonry surfaces**. Use detergent and soft brushes or cloths.

C. **Clean mortar and debris from roof**; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.

D. **Remove masking materials**, leaving no residues that could trap dirt.

3.6 MASONRY WASTE DISPOSAL

A. **Salvageable Materials**: Unless otherwise indicated, excess masonry materials are Contractor's property.

B. **Masonry Waste**: Remove masonry waste and legally dispose of off Owner's property.

END OF SECTION

SECTION 04 2200

UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This **Section includes** unit masonry assemblies consisting of the following:
1. Concrete masonry units (CMU.
2. Mortar and grout.
3. Reinforcing steel.
4. Masonry joint reinforcement.
6. Miscellaneous masonry accessories.

B. **Products installed, but not furnished**, under this Section include the following:
1. Steel lintels and shelf angles for unit masonry, furnished under Division 5 Section "Metal Fabrications."
2. Hollow-metal frames in unit masonry openings, furnished under Division 8 Section "Hollow Metal Doors and Frames."

1.3 DEFINITIONS

A. **Reinforced Masonry**: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

A. **Provide unit masonry** that develops the following net-area compressive strengths (f'm) at 28 days. Determine compressive strength of masonry by testing masonry prisms according to ASTM C 1314.
1. For Concrete Unit Masonry: f'm = As indicated on Structural Drawings.

1.5 SUBMITTALS

A. **Product Data**: For each different masonry unit, accessory, and other manufactured product specified.

B. **Shop Drawings**: Show fabrication and installation details for the following:
1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."

C. **Samples:** Pigmented mortar, minimum 3 inches long and width of typical joint. Make samples using same sand and mortar ingredients to be used on Project.

D. **Material Test Reports**: From a qualified testing agency indicating and interpreting test results of the following for compliance with requirements indicated:
1. Each type of masonry unit required.
   a. Include test results, measurements, and calculations establishing net-area compressive strength of masonry units.
2. Mortar complying with property requirements of ASTM C 270.
3. Grout mixes complying with compressive strength requirements of ASTM C 476. Include description of type and proportions of grout ingredients.

E. **Material Certificates**: Signed by manufacturers certifying that each of the following items complies with requirements:
1. Each type of masonry unit required.
   a. Include test data, measurements, and calculations establishing net-area compressive strength of masonry units.
2. Each cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.
3. Each combination of masonry unit type and mortar type. Include statement of net-area compressive strength of masonry units, mortar type, and net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
4. Each material and grade indicated for reinforcing bars.
5. Each type and size of joint reinforcement.
6. Each type and size of anchor, tie, and metal accessory.

F. **Cold-Weather Procedures**: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements as per TMS 602-08/ACI 530.1-08/ASCE 6-08.

1.6 QUALITY ASSURANCE

A. **Testing Agency Qualifications**: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1093 to conduct the testing indicated, as documented according to ASTM E 548.

B. **Source Limitations for Masonry Units**: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

C. **Source Limitations for Mortar Materials**: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

D. **Preconstruction Testing Service**: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by Owner. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.
1. Concrete Masonry Unit Test: For each concrete masonry unit indicated, per ASTM C 140.
2. Mortar Test: For mortar properties per ASTM C 270.
3. Grout Test: For compressive strength per ASTM C 1019.

E. **Pre-installation Conference**: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Coordination and Management."

1.7 DELIVERY, STORAGE, AND HANDLING

A. **Store masonry units** on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. **Store cementitious materials** on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. **Store aggregates** where grading and other required characteristics can be maintained and contamination avoided.

D. **Store masonry accessories**, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 PROJECT CONDITIONS

A. **Protection of Masonry**: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work, except when the ambient temperature is expected to remain above 65 degrees F and no rain is forecast for the next 24 hours. (This is to prevent condensation from covered walls causing a moisture problem.) Cover partially completed masonry each day that construction is not in progress. Walls are to be protected until they are permanently protected by the roofing membrane over the cap plate. Provide temporary protection immediately following the topping out of each section of wall by installing waterproof sheeting over the cap plate until the roofing membrane is installed. A solid grouted top bond beam shall not be considered adequate protection for the wall.
   1. Extend cover a minimum of 24 inches (600 mm) down both sides and hold cover securely in place.
   2. Protection shall remain in place until final weatherproof covering has been installed. Once masonry work has commenced the Contractor shall reimburse the Owner the sum of $500.00 per day that the masonry work is not protected.

B. **Do not apply uniform floor or roof loads** for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. **Stain Prevention**: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by coverings spread on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
   4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
   5. Provide temporary edge on floor slabs to prevent moisture from draining over the edge of the floor slabs and down walls

D. **Cold-Weather Requirements**: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602-08/ACI 530.01/ASCE 6-08 as referenced in the International Building Code, section 2104.3 when ambient temperature is 40 degrees F or below.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 degrees F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
2. Comply with the following requirements during construction when the following ambient air temperatures exist:
    a. 40 degrees F to 32 degrees F: Heat sand or mixing water to produce mortar temperature between 40 degrees F and 120 degrees F at the time of mixing. Grout does not require heated materials, unless the temperature of the materials is below 32 degrees F.
    b. Below 32 degrees F to 25 degrees F: Heat sand and mixing water to produce mortar temperature between 40 degrees F and 120 degrees F at the time of mixing. Maintain mortar temperature above freezing until used in masonry. Heat grout aggregates and mixing water to produce grout temperature between 70 degrees F and 120 degrees F at the time of mixing. Maintain grout temperature above 70 degrees F at the time of grout placement.
    c. Below 25 degrees F to 20 degrees F: Comply with paragraph 1.8 D.2.b above and the following: Heat masonry surfaces under construction to 40 degrees F. and use wind breaks or enclosures when the wind velocity exceeds 15 mph. Heat masonry to a minimum of 40 degrees F prior to grouting.
    d. Below 20 degrees F: Comply with paragraph 1.8 D.2.c above and the following: Provide an enclosure and auxiliary heat to maintain air temperature above 32 degrees F within the enclosure.
3. Comply with the following requirements after masonry is placed when the following minimum daily temperatures exist:
    a. 40 degrees F to 25 degrees F: Protect newly constructed masonry by covering with a weather-resistive membrane for 24 hours after completion.
    b. Below 25 degrees F to 20 degrees F: Cover newly constructed masonry completely with weather-resistive insulating blankets, or equal protection, for 24 hours after completion of work. Extend time period to 48 hours for grouted masonry, unless the only cement in the grout is Type III Portland cement.
    c. Below 20 degrees F: Maintain newly constructed masonry temperature above 32 degrees F for at least 24 hours after being completed by using heated enclosures, electric heating blanket, infrared lamps, or other means acceptable to the Architect. Extend time period to 48 hours for grouted masonry, unless the only cement in the grout is Type III Portand cement.

E. **Hot-Weather Requirements**: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required. Comply with hot-weather construction requirements contained in TMS 602-08/ACI 530.01/ASCE 6-08 as referenced in the International Building Code, section 2104.3 when ambient temperature exceeds 100 degrees F.
   1. When ambient temperature exceeds 100 degrees F, or 90 degrees F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.
   2. Maintain temperature of grout and mortar below 120 degrees F. Maintain sand piles in a damp, loose condition.
   3. When the mean daily temperature exceeds 100 degrees F or exceeds 90 degrees F with a wind velocity greater than 8 mph, fog spray newly constructed masonry until damp, at least 3 times per day until the masonry is 3 days old.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. **Defective Units**: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

2.2 CONCRETE MASONRY UNITS

A. **General**: Provide shapes indicated and as follows:
   1. Provide special shapes for lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.
   2. At interior walls, provide chamfered units for outside corners, unless otherwise indicated.

B. **Concrete Masonry Units**: ASTM C 90-00 and as follows (standard units)
   1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000 psi, minimum.
   2. Weight Classification: Light weight. (Minimum weight of 103 lbs per cu. ft.)
   3. Size (Width): Manufactured to the following dimensions:
      a. 4 inches nominal, 3 5/8 inches actual.
      b. 8 inches nominal; 7-5/8 inches actual.
      c. 12 inches nominal; 11-5/8 inches actual.
   4. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.
      a. Where units are to be left exposed and painted, provide color and texture matching the range represented by Architect's sample.

2.3 MORTAR AND GROUT MATERIALS

A. **Portland Cement**: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
   1. Where no mortar color is indicated on the Drawings, Architect shall select color(s) from manufacturer's full range.
   2. Free alkali in cements used in mortar shall be less than 0.1 percent to avoid efflorescence.

B. **Hydrated Lime**: ASTM C 207, Type S.

C. **Aggregate for Mortar**: ASTM C 144; except for joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.

D. **Aggregate for Grout**: ASTM C 404.

E. **Water**: Potable.

2.4 REINFORCING STEEL

A. **Uncoated Steel Reinforcing Bars**: ASTM A 615 Grade 60.

2.5 MASONRY JOINT REINFORCEMENT

A. **General**: ASTM A 951 and as follows:
   1. Hot-dip galvanized, carbon-steel wire for both interior and exterior walls.
   2. Wire Size for Side Rods: W1.7 or 0.148-inch diameter.
   3. Wire Size for Cross Rods: W1.7 or 0.148-inch diameter.
   4. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units where indicated.

B. **For single-wythe masonry**, provide either ladder or truss type with single pair of side rods and cross rods spaced not more than 16 inches o.c.

2.6 MISCELLANEOUS ANCHORS

A. **Anchor Bolts**: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of diameter and length indicated and in the following configurations:
   1. Non-headed bolts, bent in manner indicated.

B. **Postinstalled Anchors**: Anchors as described below, with capability to sustain, without failure, load imposed within factors of safety indicated, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
   1. Type: Expansion anchors.
   2. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 service condition (mild).
   3. For Post-installed Anchors in Concrete: Capability to sustain, without failure, a load equal to four times the loads imposed.
   4. For Post-installed Anchors in Grouted Masonry Units: Capability to sustain, without failure, a load equal to six times the loads imposed.

2.7 MISCELLANEOUS MASONRY ACCESSORIES

A. **Compressible Filler**: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. **Preformed Control-Joint Gaskets**: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
   1. Styrene-Butadiene-Rubber Compound: ASTM D 2000, Designation M2AA-805.

C. **Bond-Breaker Strips**: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

2.8 MASONRY CLEANERS

A. **Job-Mixed Detergent Solution**: Solution of 1/2-cup dry measure tetrasodium polyphosphate and 1/2-cup dry measure laundry detergent dissolved in 1 gallon of water.

2.9 MORTAR AND GROUT MIXES

A. **General**: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
   1. Do not use calcium chloride in mortar or grout.

B. **Mortar for Unit Masonry**: Comply with ASTM C 270, Proportion Specification, Type S and as indicated on the structural drawings.

C. **Grout for Unit Masonry**: Comply with ASTM C 476, type as indicated on the structural drawings.

2.10 SOURCE QUALITY CONTROL

A. **Owner reserves the right to engage** a qualified independent testing agency to perform source quality-control testing indicated below.
   1. Payment for these services will be made by Owner.
   2. Re-testing of materials failing to meet specified requirements shall be done at Contractor's expense.

B. **Concrete Masonry Unit Tests**: For each type of concrete masonry unit indicated, units will be tested according to ASTM C 140.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Examine conditions**, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance.
   2. Verify that substrates are within tolerances specified.
   3. Verify that reinforcing dowels are properly placed.
   4. Proceed with installation only after unsatisfactory conditions have been corrected.

B. **Before installation**, examine rough-in and built-in construction to verify actual locations of piping connections.

3.2 INSTALLATION, GENERAL

A. **Thickness**: Build single-wythe walls to the actual widths of masonry units, using units of widths indicated.

B. **Build chases** and recesses to accommodate items specified in this Section and in other Sections of the Specifications.

C. **Leave openings** for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to the opening.

D. **Cut masonry units** with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide a continuous pattern and to fit adjoining construction. Where possible, use full-size units without cutting. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. **Wetting of Masonry**: Wet masonry before laying if the initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at the time of laying. Do not overwet masonry so as to promote efflorescence.

3.3 CONSTRUCTION TOLERANCES

A. **Comply** with tolerances in ACI 530.1/ASCE 6/TMS 602 and the following:

B. **For conspicuous vertical lines**, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/4 inch in 20 feet, nor 1/2 inch maximum.

C. **For vertical alignment of exposed head joints**, do not vary from plumb by more than 1/4 inch in 10 feet, nor 1/2 inch maximum.

D. **For conspicuous horizontal lines**, such as exposed lintels, sills, parapets, and reveals, do not vary from level by more than 1/4 inch in 20 feet, nor 1/2 inch maximum.

E. **For exposed head joints**, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.

3.4 LAYING MASONRY WALLS

A. **Lay out walls** in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. **Bond Pattern for Exposed Masonry**: Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
   1. One-half running bond with vertical joint in each course centered on units in courses above and below.
   2. Patterns shall match existing.

C. **Lay concealed masonry** with all units in a wythe in running bond. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. **Stopping and Resuming Work**: In each course, rack back one-half-unit length for one-half running bond or one-third-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, and remove loose masonry units and mortar before laying fresh masonry.

E. **Built-in Work**: As construction progresses, build in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.

F. **Fill space** between hollow-metal frames and masonry solidly with mortar, unless otherwise indicated.

G. **Where built-in items are to be embedded** in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

H. **Fill cores** in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

I. **Build non-load-bearing** interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.
   1. Install compressible filler in joint between top of partition and underside of structure above.

3.5 MORTAR BEDDING AND JOINTING

A. **Lay hollow masonry units as follows**:
   1. With full mortar coverage on horizontal and vertical face shells.
   2. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
   3. For starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells.

B. **Interior Joints**:
   1. Interior Smooth/Honed/Standard Face Masonry: Joints slightly concave using a jointer larger than joint thickness.

3.6 MASONRY JOINT REINFORCEMENT

A. **General**: Provide continuous masonry joint reinforcement at areas of brick veneer. Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
   1. Space reinforcement not more than 16 inches o.c.

3.7 CONTROL AND EXPANSION JOINTS

A. **General**: Install control and expansion joints in unit masonry where indicated. Build-in related items as masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.

B. **Form control joints in concrete masonry as follows**:
   1. Install preformed control-joint gaskets designed to fit standard sash block.

C. **Build in horizontal, pressure-relieving joints** where indicated; construct joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 7 Section "Joint Sealants."

3.8 REINFORCED UNIT MASONRY INSTALLATION

A. **Temporary Formwork and Shores**: Construct formwork and shores to support reinforced masonry elements during construction.
   1. Construct formwork to conform to shape, line, and dimensions shown. Make it sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
   2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

B. **Placing Reinforcement**: Comply with requirements of ACI 530.1/ASCE 6/TMS 602.

C. **Grouting**: Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.
   1. Comply with requirements of ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.9 FIELD QUALITY CONTROL

A. **Owner will engage a qualified independent testing agency** to perform field quality-control testing indicated below.
   1. Payment for these services will be made by Owner.
   2. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.

B. **Testing Frequency**: Tests and Evaluations listed in this Article will be performed during construction for each 5000 sq. ft. of wall area or portion thereof.

C. **Mortar properties** will be tested per ASTM C 780. Test mortar for mortar air content, water-repellent admixture and compressive strength.

D. **Grout** will be sampled and tested for compressive strength per ASTM C 1019.

E. **Concrete Masonry Unit Tests**: For each type of concrete masonry unit indicated, units will be tested according to ASTM C 140.

3.10 REPAIRING, POINTING, AND CLEANING

A. **Remove and replace masonry units** that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. **Pointing**: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application.

C. **In-Progress Cleaning**: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. **Final Cleaning**: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
   3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
   4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing the surfaces thoroughly with clear water.
   5. Clean brick by the bucket-and-brush hand-cleaning method described in BIA Technical Notes No. 20, using job-mixed detergent solution.

3.12 MASONRY WASTE DISPOSAL

A. **Excess Masonry Waste**: Remove excess masonry waste and legally dispose of off Owner's property.

END OF SECTION

DIVISION 5 - METALS

Section 05 5000 Metal Fabrications

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SECTION 05 5000

METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. **This Section includes the following**:
1. Loose bearing and leveling plates.
2. Shelf angles.
3. Steel framing and supports for countertops.
4. Steel framing and supports for mechanical and electrical equipment.
5. Steel framing and supports for applications where framing and supports are not specified in other Sections.
6. Miscellaneous metal trim, including stainless steel pipe enclosures.

B. **Related Sections** include the following:
1. Section 06 1053 **"Miscellaneous Rough Carpentry"** for metal framing anchors and other rough hardware.

1.3 SUBMITTALS

A. **Product Data**: For the following:
1. Paint products.
2. Grout.

B. **Shop Drawings**: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
1. Provide templates for anchors and bolts specified for installation under other Sections.

C. **Samples for Verification**: For each type and finish of extruded nosing and tread.

D. **Welding Certificates**: Copies of certificates for welding procedures and personnel.

E. **Qualification Data**: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.4 QUALITY ASSURANCE

A. **Fabricator Qualifications**: A firm experienced in producing metal fabrications 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. **Welding**: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.3, "Structural Welding Code--Sheet Steel."
4. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

C. **Metal Bar Grating Standards**: Comply with applicable requirements of the following:
1. Non-Heavy-Duty Metal Bar Gratings: Comply with NAAMM MBG 531, "Metal Bar Grating Manual for Steel, Stainless Steel, and Aluminum Gratings and Stair Treads

1.5 PROJECT CONDITIONS

A. **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.
1. **Established Dimensions**: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.

1.7 COORDINATION

A. **Coordinate installation** of anchorages for metal fabrications. 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.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. **Metal Surfaces, General**: 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. **Hot dip galvanize** exterior metals and metal exposed to weather and where indicated on Drawings.

2.2 FERROUS METALS

A. **Steel Plates, Shapes, and Bars**: ASTM A 36/A 36M.

B. **Steel Tubing**: Cold-formed steel tubing complying with ASTM A 500.

C. **Steel Pipe**: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

D. **Slotted Channel Framing**: Cold-formed metal channels with flange edges returned toward web and with 9/16-inch- wide slotted holes in webs at 2 inches o.c.
1. Width of Channels: 1-5/8 inches.
2. Depth of Channels: 1-5/8 inches.
3. Metal and Thickness: Uncoated steel complying with ASTM A 570, Grade 33; 0.0677-inch minimum thickness.
4. Finish: Rust-inhibitive, baked-on, acrylic enamel.

E. **Cast-in-Place Anchors in Concrete**: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27 cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153.

F. **Welding Rods and Bare Electrodes**: Select according to AWS specifications for metal alloy welded.

G. **Stainless-Steel Sheet**: ASTM A 240/A 240M or ASTM A 666, Type 316, <Insert dimension> thick.
1. Finish: No. 4.

2.3 PAINT

A. **Shop Primer for Ferrous Metal**: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.
1. Refer to Section 09900 - Painting for specific primer required on identified steel items.

B. **Galvanizing Repair Paint**: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

C. **Bituminous Paint**: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 FASTENERS

A. **General**: Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.

B. **Bolts and Nuts**: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. **Anchor Bolts**: ASTM F 1554, Grade 36.

D. **Machine Screws**: ASME B18.6.3.

E. **Lag Bolts**: ASME B18.2.1.

F. **Wood Screws**: Flat head, carbon steel, ASME B18.6.1.

G. **Plain Washers**: Round, carbon steel, ASME B18.22.1.

H. **Lock Washers**: Helical, spring type, carbon steel, ASME B18.21.1.

I. **Expansion Anchors**: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
   1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

J. **Toggle Bolts**: FS FF-B-588, tumble-wing type, class and style as needed.

2.5 GROUT

A. **Nonshrink, Nonmetallic Grout**: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 CONCRETE FILL

A. **Concrete Materials and Properties**: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 4000 psi, unless otherwise indicated.

2.7 FABRICATION, GENERAL

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.

B. **Shear and punch** metals cleanly and accurately. Remove burrs.

C. **Ease exposed edges** to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. **Weld corners and seams continuously to comply with the following**:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

E. **Provide for anchorage** of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices 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.

G. **Fabricate joints** that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

H. **Allow for thermal movement** resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 degrees F, ambient; 180 degrees F, material surfaces.

I. **Form exposed work true to line** and level with accurate angles and surfaces and straight sharp edges.

J. **Remove sharp or rough areas** on exposed traffic surfaces.

K. **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.

2.8 LOOSE BEARING AND LEVELING PLATES

A. **Provide loose bearing and leveling plates** for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. **Galvanize plates after** fabrication.

2.9 SHELF ANGLES

A. **Fabricate shelf angles** from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.

B. **For cavity walls**, provide vertical channel brackets to support angles from backup masonry and concrete. Align expansion joints in angles with indicated control and expansion joints in cavity-wall exterior wythe.

C. **Galvanize shelf angles** to be installed in exterior walls.

D. **Furnish wedge-type concrete inserts**, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.10 MISCELLANEOUS FRAMING AND SUPPORTS

A. **General**: Provide steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work.

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. Fabricate units from slotted channel framing where indicated.
   2. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors 1-1/4 inches wide by 1/4 inch thick by 8 inches long at 24 inches o.c., unless otherwise indicated.
   3. Furnish inserts if units must be installed after concrete is placed.

C. **Galvanize miscellaneous framing and supports in the following locations**:
   1. Exterior locations and where miscellaneous items will be concealed from view.

2.11 MISCELLANEOUS STEEL TRIM

A. **Unless otherwise indicated,** fabricate units from structural-steel shapes, plates, and bars of profiles shown with continuously welded joints, and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. **Provide cutouts,** fittings, and anchorages as needed to coordinate assembly and installation with other work. Provide anchors, welded to trim, for embedding in concrete or masonry construction, spaced not more than 6 inches from each end, 6 inches from corners, and 24 inches o.c., unless otherwise indicated.

C. **Galvanize miscellaneous steel trim in the following locations**:
   1. Exterior.

D. Stainless Steel Pipe Enclosures:

1. Enclosures may be fabricated from prefinished stainless steel sheet in lieu of finishing after fabrication provided unfinished edges are concealed from view.
2. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide flat surfaces where indicated.
3. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
4. Form returns at vertical joints to provide hairline V-joints.
5.

2.13 FINISHES, GENERAL

A. **Comply with NAAMM**'s "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. **Finish metal fabrications** after assembly.

2.14 STEEL AND IRON FINISHES

A. **Galvanizing**: Hot-dip galvanize items as indicated to comply with applicable standard listed below:

1. ASTM A 123, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

B. **Preparation for Shop Priming**: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

C. **Apply shop primer** to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.15 STAINLESS-STEEL FINISHES

A. **Surface Preparation**: Remove tool and die marks and stretch lines, or blend into finish.

B. **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. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

C. **Directional Satin Finish**: No. 4.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. **Fastening to In-Place Construction**: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.

B. **Cutting, Fitting, and Placement**: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. **Provide temporary bracing** or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

D. **Fit exposed connections** accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. **Field Welding**: Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. **Corrosion Protection**: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.4 INSTALLING METAL BAR GRATINGS

A. **General:** Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. **Attach removable units to supporting members** with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

C. **Attach non-removable units to supporting members** by bolting or welding as indicated on shop drawings or as directed by Architect.

3.5 SETTING BEARING AND LEVELING PLATES

A. **Clean concrete and masonry bearing surfaces** of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. **Set bearing and leveling plates** on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations, unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.6 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. **General**: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings, if any.

B. **Support steel girders** on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
1. Where grout space under bearing plates is indicated at girders supported on concrete or masonry, install as specified above for setting and grouting bearing and leveling plates.

3.7 PIPE ENCLOSURE INSTALLATION

A. **Locate and place column covers** plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install column covers.
1. 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.

B. **Use concealed anchorages** where possible.

C. **Form tight joints** with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.

3.8 ADJUSTING AND CLEANING

A. **Touchup Painting**: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the 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.

B. **Galvanized Surfaces**: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

C. **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.

3.9 PROTECTION

A. **Protect finishes from damage** during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION

DIVISION 6 - WOOD AND PLASTIC

Section 06 1053 Miscellaneous Rough Carpentry

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SECTION 06 1053

MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This **Section includes** the following:
   1. Rooftop equipment bases and support curbs.
   2. Wood furring, grounds, nailers, and blocking.
   3. Wood based structural use panels.
   4. Plywood backing panels (for telephone and electrical equipment).

1.3 SUBMITTALS

A. **Wood treatment data as follows**, including chemical treatment manufacturer's instructions for handling, storing, installing, and finishing treated materials:
   1. For each type of preservative-treated wood product, include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
   2. For waterborne-treated products, include statement that moisture content of treated materials was reduced to levels indicated before shipment to Project site.

B. **Submit research reports** or evaluation reports of the model code organization acceptable to authorities having jurisdiction evidencing compliance of the following wood products with specified requirements and building code in effect for Project.
   1. Engineered wood products.

C. **Material test reports** from a qualified independent testing agency indicating and interpreting test results relative to compliance of fire-retardant-treated wood products with performance requirements indicated.

D. **Warranty of chemical treatment** manufacturer for each type of treatment.

1.4 DELIVERY, STORAGE, AND HANDLING

A. **Keep materials under cover and dry**. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings.
   1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

A. **Lumber Standards**: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.

B. **Inspection Agencies**: Inspection agencies, and the abbreviations used to reference them, include the following:
1. NELMA - Northeastern Lumber Manufacturers Association.
2. RIS - Redwood Inspection Service.
3. SPIB - Southern Pine Inspection Bureau.
4. WCLIB - West Coast Lumber Inspection Bureau.
5. WWPA - Western Wood Products Association.

C. **Grade Stamps**: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
1. For exposed lumber, furnish pieces with grade stamps applied to ends or back of each piece.

D. **Nominal Sizes**: Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
1. Provide dressed lumber, S4S, unless otherwise indicated.
2. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal (38-mm actual) thickness or less, unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. **General**: Where lumber or plywood is indicated as preservative treated or is specified to be treated, comply with applicable requirements of AWPA C2 (lumber) and AWPA C9 (plywood). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC's Board of Review.
1. Do not use chemicals containing chromium or arsenic.
2. For exposed items indicated to receive stained finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

B. **Pressure treat aboveground items** with waterborne preservatives to a minimum retention of 0.25 lb/cu. ft. After treatment, kiln-dry lumber and plywood to a maximum moisture content of 19 and 15 percent, respectively. Treat indicated items and the following:
1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

C. **Pressure treat wood members in contact with ground** or freshwater with waterborne preservatives to a minimum retention of 0.40 lb/cu. ft.

2.4 FIRE-RETARDANT TREATMENT BY PRESSURE PROCESS

A. **General**: Where fire-retardant-treated wood is indicated, pressure impregnate lumber and plywood with fire-retardant chemicals to comply with AWPA C20 and C27, respectively, for treatment type indicated; identify "fire-retardant-treated wood" with appropriate classification marking of Underwriters Laboratories, Inc., U.S. Testing, Timber Products Inspection, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Current Evaluation/Research Reports: Provide fire-retardant- treated wood for which a current model code evaluation/research report exists that is acceptable to authorities having jurisdiction and that evidences compliance of fire-retardant-treated wood for application indicated.

B. **Interior Type A**: For interior locations use fire-retardant chemical formulation that produces treated lumber and plywood with the following properties under conditions present after installation:
   1. No reduction takes place in bending strength, stiffness, and fastener holding capacities below values published by manufacturer of chemical formulation that are based on tests by a qualified independent testing laboratory of treated wood products identical to those indicated for this Project under elevated temperature and humidity conditions simulating installed conditions.
   2. No other form of degradation occurs due to acid hydrolysis or other causes related to manufacture and treatment.
   3. No corrosion of metal fasteners results from their contact with treated wood.

C. **Exterior Type**: Use for exterior locations and where indicated.

D. **Inspection**: Inspect each piece of treated lumber or plywood after drying and discard damaged or defective pieces.

E. **Products**: Subject to compliance with requirements of Contract Documents, provide one of the following:
   1. Interior Type A Fire-Retardant-Treated Wood:
      a. "Dricon" Hickson Corporation.
      b. "Pyro-Guard" Hoover Treated Wood Products.
      c. "Flameproof LHC-HTT" Osmose Wood Preserving Co, Inc.
   2. Exterior Type Fire-Retardant-Treated Wood:
      a. "Exterior Fire-X" Hoover Treated Wood Products.

2.5 DIMENSION LUMBER

A. **General**: Provide dimension lumber of grades indicated according to the ALSC National Grading Rule (NGR) provisions of the inspection agency indicated.
   1. Grade: Standard, Stud, or No. 3.
   2. Species: Hem-fir; WCLIB or WWPA.

2.6 MISCELLANEOUS LUMBER

A. **General**: Provide lumber for support or attachment of other construction, including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.

B. **Fabricate miscellaneous lumber** from dimension lumber of sizes indicated and into shapes shown.

C. **Moisture Content**: 19 percent maximum for lumber items are not specified to receive wood preservative treatment.

D. **Grade**: For dimension lumber sizes, provide No. 3 or Standard grade lumber per ALSC's NGRs of any species. For board-size lumber, provide No. 3 Common grade per NELMA, NLGA, or WWPA; No. 2 grade per SPIB; or Standard grade per NLGA, WCLIB or WWPA of any species.

2.7 WOOD-BASED STRUCTURAL-USE PANELS

A. **Miscellaneous Concealed Plywood**: C-C Plugged Exterior, thickness as indicated but not less than 1/2 inch.

B. **Miscellaneous Exposed Plywood**: A-D Interior, thickness as indicated but not less than 1/2 inch.

2.8 PLYWOOD BACKING PANELS

A. **For mounting electrical** or **telephone** equipment, provide fire-retardant-treated plywood panels with grade, C-D Plugged Exposure 1, in thickness indicated or, if not otherwise indicated, not less than 15/32 inch thick.

2.9 FASTENERS

A. **General**: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
   1. Where miscellaneous carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of Type 304 stainless steel.

B. **Nails, Wire, Brads, and Staples**: FS FF-N-105.

C. **Power-Driven Fasteners**: CABO NER-272.

D. **Bolts**: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. **Discard units of material with defects** that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.

B. **Set carpentry to required levels** and lines, with members plumb, true to line, cut, and fitted.

C. **Fit carpentry to other construction**; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.

D. **Apply field treatment** complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.

E. **Securely attach carpentry work** as indicated and according to applicable codes and recognized standards.

F. **Countersink nail heads** on exposed carpentry work and fill holes with wood filler.

G. **Use fasteners of appropriate type and length**. Predrill members when necessary to avoid splitting wood.

3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

A. **Install where shown** and where required for screeding or attaching other work. Cut and shape to required size. Coordinate locations with other work involved.

B. **Attach to substrates** to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

3.3 WOOD FURRING

A. Install plumb and level with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

3.4 INSTALLATION OF STRUCTURAL-USE PANELS

A. **General**: Comply with applicable recommendations contained in APA Form No. E30, "APA Design/Construction Guide: Residential & Commercial," for types of structural-use panels and applications indicated.
   1. Comply with "Code Plus" provisions of above-referenced guide.

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DIVISION 7 - THERMAL AND MOISTURE PROTECTION

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SECTION 07 5420

POLYVINYL-CHLORIDE (PVC) ROOFING

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. Tear-off of roof areas indicated, including existing insulation.
   2. Mechanically fastened PVC membrane roofing system, including roof edges.

1.3 DEFINITIONS

A. **Roofing Terminology**: See ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

1.4 PERFORMANCE REQUIREMENTS

A. **General Performance**: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

B. **Material Compatibility**: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

C. **Roofing System Design**: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.

D. **FM Approvals Listing**: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system. Identify materials with FM Approvals markings.
   1. Fire/Windstorm Classification: As required for warranted installation in project location and with minimum 100 mph wind speed.

1.5 SUBMITTALS

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

B. **Shop Drawings**: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
   1. Base flashings and membrane terminations.

C. **Samples for Verification**: For the following products:
   1. Sheet roofing, of color specified, including T-shaped side and end lap seam.
   2. Walkway pads.

3. Six roof cover fasteners of each type, length, and finish.
4. 12 inch piece of each type of sheet metal flashing and trim in color to match existing conditions.

D. **Qualification Data**: For qualified Installer and manufacturer.

E. **Manufacturer Certificates**: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
1. Submit evidence of compliance with performance requirements.

F. **Product Test Reports**: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.

G. **Research/Evaluation Reports**: For components of membrane roofing system, from the ICC-ES.

H. **Maintenance Data**: For roofing system to include in maintenance manuals.

I. **Warranties**: Sample of special warranties.

1.6 QUALITY ASSURANCE

A. **Manufacturer Qualifications**: A qualified manufacturer that is UL listed for membrane roofing system identical to that used for this Project.

B. **Installer Qualifications**: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

C. **Source Limitations**: Obtain components including fasteners for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.

D. **Exterior Fire-Test Exposure**: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

E. **Pre-installation Roofing Conference:** Conduct conference at Project site.
1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing system tear-off and replacement, including, but not limited to, the following:
    a. Reroofing preparation, including roofing system manufacturer's written instructions.
    b. Temporary protection requirements for existing roofing system components that are to remain.
    c. Existing roof drains and roof drainage during each stage of reroofing, and roof-drain plugging and plug removal.
    d. Existing roof deck conditions requiring notification of Architect.
    e. Existing roof deck removal procedures and Owner notifications.

f. Condition and acceptance of existing roof deck and base flashing substrate for reuse.
g. Structural loading limitations of roof deck during reroofing.
h. Base flashings, special roofing details, drainage, penetrations, equipment curbs, and condition of other construction that affect reroofing.
i. HVAC shutdown and sealing of air intakes.

3. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
4. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
5. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
6. Review structural loading limitations of roof deck during and after roofing.
7. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
8. Review governing regulations and requirements for insurance and certificates if applicable.
9. Review temporary protection requirements for roofing system during and after installation.
10. Review roof observation and repair procedures after roofing installation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. **Deliver roofing materials to Project site in original containers** with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. **Store liquid materials in their original undamaged containers** in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. **Handle and store roofing materials** and place equipment in a manner **to avoid permanent deflection of deck**.

1.8 PROJECT CONDITIONS

A. **Owner will occupy portions of building immediately below** reroofing area. Conduct reroofing so Owner's operations are not disrupted. Provide Owner with not less than 72 hours' notice of activities that may affect Owner's operations.
1. Coordinate work activities daily with Owner so Owner can place protective dust and water-leakage covers over sensitive equipment and furnishings, shut down HVAC and fire-alarm or -detection equipment if needed, and evacuate occupants from below work area.
2. Before working over structurally impaired areas of deck, notify Owner to evacuate occupants from below affected area. Verify that occupants below work area have been evacuated before proceeding with work over impaired deck area.

B. **Protect building to be reroofed**, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.

C. **Maintain access** to existing walkways, corridors, and other adjacent occupied or used facilities.

D. **Conditions existing at time of inspection** for bidding are maintained by Owner as far as practical.
1. Construction Documents are provided for Contractor's convenience and information, but are not a warranty of existing conditions. They are intended to supplement rather than serve in lieu of Contractor's own investigations. Contractor is responsible for conclusions derived from existing documents.

E. **Weather Limitations**: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.
1. Remove only as much roofing in one day as can be made watertight in the same day**.**

1.9 WARRANTY

A. **Special Warranty**: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
1. Special warranty includes membrane roofing, base flashings, fasteners, insulation, cover board, roofing accessories, walkway products, and other components of membrane roofing system, including roof edge materials.
2. Warranty shall allow for **wind speed** of **100 mph** for the length of the warranty.
3. **Warranty Period: 20 years** from date of Substantial Completion.

B. **Special Project Warranty**: Submit roofing Installer's warranty, on warranty form approved by Owner, signed by Installer, covering the Work of this Section, including all components of membrane roofing system such as membrane roofing, base flashing, fasteners, insulation, cover board, roofing accessories and walkway products, for the following warranty period:
1. **Warranty Period: Five years** from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PVC MEMBRANE ROOFING

A. **Basis of Design**: Contract Documents are based on products listed below to establish a standard of quality. Other acceptable manufacturers offering products with equivalent characteristics may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.
1. Manufacturer: Sika Sarnafil; usa.sarnafil.sika.com
2. Product: Sarnafil S327 Roof Membrane.

B. **Acceptable Manufacturers**: Subject to compliance with requirements of Contract Documents, provide system by one of the following manufacturers. If not listed, submit as a substitution according to the Conditions of the Contract and provisions of Division 1 sections.
1. Carlisle SynTec
2. Firestone
3. Sika Sarnafil.
4. Substitutions as noted above and accepted by Owner via Addenda.

C. **PVC Sheet**: ASTM D 4434, Type III, coated, polyester scrim reinforced. Membrane must be manufactured by the company supplying the warranty (no private labeling) with a minimum 20 year successful track record.
   1. Thickness: **60 mils**, nominal, with minimum 28 mils above reinforcing.
   2. Exposed Face Color: White.

2.2 AUXILIARY MEMBRANE ROOFING MATERIALS

A. **General**: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.
   1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. **Sheet Flashing**: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet membrane.

C. **Bonding Adhesive**: Manufacturer's standard.

D. **Metal Termination Bars**: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

E. **Fasteners**: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.

F. **Coated Flashings**: Manufacturer’s standard PVC coated metal flashings in thickness as recommended by manufacturer for indicated use and complying with performance requirements, but with metal thickness not less than 0.028 inches.

G. **Miscellaneous Accessories**: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.3 INSULATION

A. **Insulation**:
   1. Field: Rigid polyisocyanurate (ASTM C 1289, Type II, Class 1, Grade 2) with black mat facers 4 feet x 8 feet installed in two layers to meet desired R-value.
   2. Taper: Rigid polystyrene, factory-tapered insulation boards fabricated to slope as indicated on Drawings. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

B. **Fasteners**: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.4 COVER BOARD

A. **Cover Board**: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch thick.

B. **Available Manufacturers**: Subject to compliance with requirements of Contract Documents, manufacturers with products which may be incorporated into the Project include, but are not limited to the following:
   1. United States Gypsum Company; “Securock Glass-Mat Roof Board”
   2. Georgia-Pacific; “DensDeck”

2.5 VAPOR BARRIER

A. **Basis of Design:** Contract Documents are based on products specified below to establish a standard of quality. Other acceptable roofing manufacturers (as noted above) offering products with equivalent characteristics may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.
   1. Manufacturer: Sika Sarnafil.
   2. Product: Sarnavap Self-Adhered.

B. **Properties:** 32 mi self-adhesive SBS modified bitumen with tri-laminated woven polyethylene facer; self-adhesive back side covered with silicone release liner.

2.6 WALKWAYS

A. **Flexible Walkways**: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16 inch thick, and acceptable to membrane roofing system manufacturer.

2.7 SHEET METAL FABRICATIONS

A. **Copings**: Fabricate in minimum 96-inch- long, but not exceeding 10-foot- long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.
   1. Joint Style: Standing seams.
   2. Fabricate copings from 22 gauge prepainted, metallic-coated steel (70 percent PDVF, AAMA 621).

C. **Roof-Drain Flashing**: Fabricate from 4.0 lb/sq. ft. , hard tempered lead.

PART 3 - EXECUTION

3.1 PREPARATION

A. **During removal operations**, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.

B. **Maintain roof drains in functioning condition** to ensure roof drainage at end of each workday. Prevent debris from entering or blocking roof drains and conductors. Use roof-drain plugs specifically designed for this purpose. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.
   1. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new roofing system, provide alternative drainage method to remove water and eliminate ponding. Do not permit water to enter into or under existing roofing system components that are to remain.

C. **Roof Tear-off**
   1. Remove existing roofing and other roofing system components down to the deck.
   2. Remove roof insulation and cover board, if any.
   3. Existing wood blocking, curbs, and nailers may remain, if sound, dry and securely anchored.
   4. Remove fasteners from deck or cut fasteners off slightly above deck surface.

D. **Clean substrate** of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

E. **Prevent materials from spilling or migrating** onto surfaces of other construction.

F. **Complete terminations and base flashings** and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

G. **Replace damaged, wet or unsound nailers** with pressure-treated lumber, matching existing in dimension.

3.2 EXAMINATION

A. **Examine substrates, areas, and conditions**, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
   1. Verify that roof openings and penetrations are in place and curbs are set and braced.
   2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations.

B. **Proceed with installation only after** unsatisfactory conditions have been corrected.

3.3 VAPOR BARRIER INSTALLATION

A. **Clean deck surface** of materials that would interfere with proper adhesion.

B. **Install membrane** in accordance with manufacturer's written instructions.

C. **Provide 6 x 42 inch metal plate** under the end lap to support the membrane between steel flutes. Stagger end laps at least 12 inches.

3.4 INSULATION INSTALLATION

A. **Coordinate installing roofing system components** so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. **Comply with roofing system and insulation manufacturer's written instructions** for installing roof insulation.

C. **Install insulation under area of roofing** to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
   1. Install tapered insulation between layers of polyisocyanurate.

D. **Trim surface of insulation** where necessary at roof drains so completed surface is flush and does not restrict flow of water.

E. **Install insulation with long joints** of insulation **in a continuous straight line** with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
   1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

F. **Mechanically Fastened Insulation**: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
   1. Fasten insulation according to requirements in FM Global's "RoofNav" for appropriate Windstorm Resistance Classification.

G. **Nailers**: Install new pressure-treated wood nailers as required to equal depth of new insulation.

3.5 COVER BOARD INSTALLATION

A. **Install cover boards over insulation** with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together and fasten to roof deck.
   1. Fasten cover boards according to requirements in FM Global's "RoofNav" for appropriate Windstorm Resistance Classification.

3.6 MECHANICALLY FASTENED MEMBRANE ROOFING INSTALLATION

A. **Mechanically fasten membrane roofing** over area to receive roofing and install according to roofing system manufacturer's written instructions.
   1. Install sheet according to ASTM D 5082.

B. **Start installation of membrane roofing** in presence of roofing system manufacturer's technical personnel.

C. **Accurately align membrane roofing** and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. **Mechanically fasten or adhere membrane roofing** securely at terminations, penetrations, and perimeter of roofing.

E. **Apply membrane roofing with side laps shingled** with slope of roof deck where possible.

F. **Seams:** Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
   1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.
   2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
   3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.

3.7 BASE FLASHING INSTALLATION

A. **Install sheet flashings and preformed flashing accessories** and adhere to substrates according to membrane roofing system manufacturer's written instructions.

B. **Apply bonding adhesive to substrate** and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.

C. **Flash penetrations** and field-formed inside and outside corners with cured or uncured sheet flashing.

D. **Clean seam areas,** overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. **Terminate and seal top** of sheet flashings.

3.8 ROOF FLASHING INSTALLATION

A. **General**: Install sheet metal roof flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.
   1. Existing copings and flashings may be reused, if undamaged, weathertight and acceptable to Owner and Architect. Roofing warranty shall include all roofing components, including copings and flashings, whether new or reused.

B. **Roof Edge Flashing**: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.
   1. Interlock bottom edge of roof edge flashing with continuous cleats anchored to substrate at 16-inch centers.

C. **Copings**: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.
   1. Interlock exterior bottom edge of coping with continuous cleats anchored to substrate at 16-inch centers.
   2. Anchor interior leg of coping with screw fasteners and washers at 18-inch centers.

D. **Pipe or Post Counterflashing**: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.

E. **Counterflashing**: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric sealant.
   1. Secure in a waterproof manner by means of snap-in installation and sealant.

F. **Roof-Penetration Flashing**: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:
   1. Seal with elastomeric sealant and clamp flashing to pipes penetrating roof except for lead flashing on vent piping.

3.9 WALKWAY INSTALLATION

A. **Flexible Walkways**: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.10 FIELD QUALITY CONTROL

A. **Testing Agency**: Owner will engage a qualified testing agency to perform tests and inspections.

B. **Final Roof Inspection**: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

C. **Repair or remove** and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

D. **Additional inspections,** at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.11 DISPOSAL

A. **Collect demolished materials** and place in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
   1. Storage or sale of demolished items or materials on-site is not permitted.

B. **Transport and legally dispose** of demolished materials off Owner's property.

3.12 PROTECTING AND CLEANING

A. **Protect membrane roofing system** from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. **Correct deficiencies** in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. **Clean overspray** and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION (Warranty form follows)

3.12 ROOFING INSTALLER'S WARRANTY

A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: _____
2. Address: _____
3. Building Name/Type: _____
4. Address: _____
5. Area of Work: _____
6. Acceptance Date: _____
7. Warranty Period: _____
8. Expiration Date: _____
9. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
10. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
11. This Warranty is made subject to the following terms and conditions:
    a. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
        1) lightning;
        2) peak gust wind speed exceeding 100 mph (44.7 m/sec);
        3) fire;
        4) failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
        5) faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
        6) vapor condensation on bottom of roofing; and
        7) activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
        8) When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
        9) Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.

10) During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.

11) During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.

12) Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.

13) This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

12. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, 20___

Authorized Signature: _____

Name: _____

Title: _____

SECTION 07 9200

JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. **This Section includes** sealants for the following applications, including those specified by reference to this Section:
   1. **Exterior joints** in the following vertical surfaces and non-traffic horizontal surfaces:
      a. Control and expansion joints in cast-in-place concrete.
      b. Control and expansion joints in unit masonry.
      c. Joints in metal panel systems.
      d. Joints between different materials listed above.
      e. Perimeter joints between materials listed above and frames of doors and windows.
      f. Control and expansion joints in soffit and overhead surfaces.
      g. Other joints as indicated.
   2. **Exterior joints** in the following horizontal traffic surfaces:
      a. Control, expansion, and isolation joints in cast-in-place concrete slabs.
      b. Tile control and expansion joints.
      c. Joints between different materials listed above.
   3. **Interior joints** in the following vertical surfaces and horizontal nontraffic surfaces:
      a. Control and expansion joints on exposed interior surfaces of exterior walls
      b. Perimeter joints of exterior openings where indicated.
      c. Control and expansion joints in ceiling and overhead surfaces.
      d. Tile control and expansion joints.
      e. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
      f. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
      g. Joints between plumbing fixtures and adjoining walls, floors, and counters.
      h. Joints between interior partitions and concrete floors.
      i. Other joints as indicated.
   4. **Interior joints** in the following horizontal traffic surfaces:
      a. Control and expansion joints in cast-in-place concrete slabs.
      b. Control and expansion joints in tile flooring.
      c. Other joints as indicated.
   5. **All joints** between dissimilar materials.

B. **Related Sections** include the following:
   1. Section 04 2200 "**Unit Masonry Assemblies**" for masonry control and expansion joint fillers and gaskets.

1.3 PERFORMANCE REQUIREMENTS

A. **Provide elastomeric joint sealants** that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

A. **Product Data**: For each joint-sealant product indicated.

B. **Samples for Selection**: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. **Product Certificates**: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

1.5 QUALITY ASSURANCE

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

B. **Source Limitations**: Obtain each type of joint sealant through one source from a single manufacturer.

C. **Preconstruction Compatibility and Adhesion Testing**: Submit to joint sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use manufacturers standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
    a. Perform tests under environmental conditions replicating those that will exist during installation.
2. Submit not fewer than nine pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
5. Testing will not be required if joint sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

D. **Mockups**: Before installing joint sealants, apply elastomeric sealants as follows to verify color selections and to demonstrate aesthetic effects and qualities of materials and execution:
   1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.
   2. Provide not less than six and not more than twelve 12 inch long x typical width and depth samples of sealants and caulks for Owner and Architect review. Samples shall be installed at floors, walls, ceiling and other locations selected by Architect

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Deliver materials** to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. **Store and handle materials** in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. **Environmental Limitations**: Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer.
   2. When joint substrates are wet.

B. **Joint-Width Conditions**: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. **Joint-Substrate Conditions**: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 WARRANTY

A. **Special Installer's Warranty**: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Three years from date of Substantial Completion.

B. **Special warranties** specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
   1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
   2. Disintegration of joint substrates from natural causes exceeding design specifications.
   3. Mechanical damage caused by individuals, tools, or other outside agents.
   4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. **Compatibility**: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. **Colors of Exposed Joint Sealants**: As selected by Architect from manufacturer's full range for this characteristic.

2.2 ELASTOMERIC JOINT SEALANTS

A. **Elastomeric Sealant Standard**: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant in the Elastomeric Joint-Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.

B. **Additional Movement Capability**: Where additional movement capability is specified in the Elastomeric Joint-Sealant Schedule, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at the time of installation and remain in compliance with other requirements of ASTM C 920 for uses indicated.

C. **Suitability for Contact with Food**: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

2.3 SOLVENT-RELEASE JOINT SEALANTS

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

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

2.4 LATEX JOINT SEALANTS

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

2.5 ACOUSTICAL JOINT SEALANTS

A. **Acoustical Sealant for Exposed and Concealed Joints**: For each product of this description indicated in the Acoustical Joint-Sealant Schedule at the end of Part 3, provide manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following:

1. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

2.6 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**: ASTM C 1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

C. **Type C**: Closed-cell material with a surface skin.

D. **Elastomeric Tubing Sealant Backings**: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F (minus 32 deg C). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

E. **Bond-Breaker Tape**: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

A. **Primer**: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. **Cleaners for Nonporous Surfaces**: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. All joints of **dissimilar materials** to receive joint sealant.

B. **Examine joints** to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

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

3.2 PREPARATION

A. **Surface Cleaning of Joints**: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include concrete, masonry or unglazed surfaces of ceramic tile.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants to metal, glass, porcelain enamel or glazed surfaces of ceramic tile.

B. **Joint Priming**: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. **Masking Tape**: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

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

B. **Sealant Installation Standard**: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. **Acoustical Sealant Application Standard**: Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. **Install sealant backings** of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. **Install bond-breaker tape** behind sealants where sealant backings are not used between sealants and back of joints.

F. **Install sealants** by proven techniques to comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses provided for each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
4. Seal abutting joint at all dissimilar materials.

G. **Tooling of Nonsag Sealants**: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealants from surfaces adjacent to joint.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint configuration, per Figure 5B in ASTM C 1193, where indicated.
5. Provide recessed joint configuration, per Figure 5C in ASTM C 1193, of recess depth and at locations indicated.
    a. Use masking tape to protect adjacent surfaces of recessed tooled joints.

3.4 CLEANING

A. **Clean off excess sealants** or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. **Protect joint sealants** during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

3.6 ELASTOMERIC JOINT-SEALANT SCHEDULE

A. **Medium-Modulus Neutral-Curing Silicone Sealant**: Where joint sealants of this type are indicated, provide products complying with the following:
   1. Products:
      a. 791; Dow Corning.
      b. PSI-631; Polymeric Systems, Inc.
      c. MasterSeal NP 150, BASF.
      d. Spectrem 2; Tremco.
   2. Type and Grade: S (single component) and NS (nonsag).
   3. Class: 25.
   4. Use Related to Exposure: NT (nontraffic).
   5. Uses Related to Joint Substrates: M (masonry), G (glass), A (aluminum), and, as applicable to joint substrates indicated, O (other).
      a. Use O Joint Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, brick and masonry, ceramic tile, and wood.
   6. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.
   7. Applications: Exterior and interior joints in vertical surfaces of concrete; between metal and concrete and mortar; perimeter of metal frames in exterior walls; overhead or ceiling joints.

B. **Mildew-Resistant Silicone Sealant**: Where joint sealants of this type are indicated, provide products formulated with fungicide that are intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and temperature extremes, and that comply with the following:
   1. Products:
      a. 786 Mildew Resistant; Dow Corning.
      b. Omniplus, Sonneborn.
      c. Sanitary 1700; GE Silicones.
      d. Tremsil 600 White; Tremco.
      e. MasterSeal NP 150, BASF
   2. Type and Grade: S (single component) and NS (nonsag).
   3. Class: 25.
   4. Use Related to Exposure: NT (nontraffic).
   5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
      a. Use O Joint Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, and ceramic tile.
   6. Applications: Interior joints in vertical surfaces of ceramic tile in toilet rooms, and showers.

C. **Multicomponent Pourable Urethane Sealant**: Where joint sealants of this type are indicated, provide products complying with the following:
   1. Products:
      a. Vulkem 245; Mameco International.
      b. Elasto-Thane 920 Pourable; Pacific Polymers, Inc.
      c. Sikaflex - 2c SL; Sika Corporation.
      d. MasterSeal SL 2; BASF.
   2. Type and Grade: M (multicomponent) and P (pourable).
   3. Class: 25.
   4. Uses Related to Exposure: T (traffic) and NT (nontraffic).
   5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.
      a. Use O Joint Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, brick and masonry, ceramic tile, and wood.
   6. Applications: Traffic joints.

D. **Single-Component Nonsag Urethane Sealant**: Where joint sealants of this type are indicated, provide products complying with the following:
   1. Products:
      a. Vulkem 921; Mameco International.
      b. Dynatrol I; Pecora Corporation.
      c. DyMonic; Tremco.
      d. MasterSeal NP1, BASF.
   2. Type and Grade: S (single component) and NS (nonsag).
   3. Class: 25
   4. Use Related to Exposure: NT (nontraffic).
   5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.
      a. Use O Joint Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, brick and masonry, ceramic tile, and wood.
   6. Applications: Joints in concrete.

3.7 LATEX JOINT-SEALANT SCHEDULE

A. **Latex Sealant**: Where joint sealants of this type are indicated, provide products complying with the following:
   1. Products:
      a. AC-20; Pecora Corporation.
      b. Tremflex 834; Tremco.
   2. Applications: Interior joints in field-painted vertical and overhead surfaces at hollow metal door frames, gypsum drywall, and concrete; and all other interior locations not indicated otherwise.

3.8 ACOUSTICAL JOINT-SEALANT SCHEDULE

A. **Acoustical Sealant for Exposed and Concealed Joints**: Where joint sealants of this type are indicated, provide products complying with the following:
   1. Products:
      a. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corporation.
      b. SHEETROCK Acoustical Sealant; USG Corp., United States Gypsum Co.
   2. Applications: Use in locations of sound walls and in locations indicated.

END OF SECTION

DIVISION 8 - DOORS AND WINDOWS

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SECTION 08 1100

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. **Section Includes**:
1. Steel doors.
2. Double rabbeted hollow metal door frames.

B. **Related Sections**
1. Section 08 7100 "**Door Hardware**" for door hardware for hollow metal doors.
2. Section 09 9123 "**Painting**" for field painting hollow metal doors and frames.

1.3 DEFINITIONS

A. **Minimum Thickness**: Minimum thickness of base metal without coatings.

B. **Standard Hollow Metal Work**: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.4 SUBMITTALS

A. **Product Data**: For each type of product indicated. Include construction details, material descriptions, core descriptions, and finishes.

B. **Shop Drawings**: Include the following:
1. Elevations of each door and window frame design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.

D. **Other Action Submittals**:
1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

E. **Oversize Construction Certification**: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

F. **Product Test Reports**: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.

1.5 QUALITY ASSURANCE

A. **Source Limitations**: Obtain hollow metal work from single source from single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Deliver** hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
   1. Provide additional protection to prevent damage to finish of factory-finished units.

B. **Deliver welded frame**s with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. **Store hollow metal work under cover at Project site**. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch-high wood blocking. Do not store in a manner that traps excess humidity.
   1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

A. **Field Measurements**: Verify actual dimensions of openings by field measurements before fabrication.

1.8 COORDINATION

A. **Coordinate installation of anchorages** for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. **Manufacturers**: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Amweld Building Products, LLC.
   2. Ceco Door Products; an Assa Abloy Group company.
   3. Curries Company; an Assa Abloy Group company.
   4. Pioneer Industries, Inc.
   5. Republic Doors and Frames.
   6. Security Metal Products Corp.
   7. Steelcraft; an Allegion company.

2.2 MATERIALS

A. **Cold-Rolled Steel Sheet:** ASTM A 1008, Commercial Steel (CS), Type B; suitable for exposed applications.

B. **Hot-Rolled Steel Sheet**: ASTM A 1011, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. **Metallic-Coated Steel Sheet**: ASTM A 653, Commercial Steel (CS), Type B; with minimum A40 metallic coating.

D. **Frame Anchors:** ASTM A 591, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008or ASTM A 1011, hot-dip galvanized according to ASTM A 153, Class B.

E. **Inserts, Bolts, and Fasteners:** Hot-dip galvanized according to ASTM A 153.

F. **Powder-Actuated Fasteners in Concrete**: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

G. **Grout:** ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143.

H. **Mineral-Fiber Insulation:** ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

I. **Glazing:** Comply with requirements in Division 8 Section "Glazing."

J. **Bituminous Coating**: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 STANDARD HOLLOW METAL DOORS

A. **General:** Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
1. Design: Flush panel.
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
3. Vertical Edges for Single-Acting Doors: Beveled edge.
   a. Beveled Edge: 1/8 inch in 2 inches.
4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- thick, end closures or channels of same material as face sheets.
5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

B. **Exterior and Wet Location (Locker Rooms) Doors:** Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Level 4 and Physical Performance Level A (Maximum Duty), Model 2 (Seamless) (14 gauge face).

C. **Hardware Reinforcement:** Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

D. **Fabricate concealed stiffeners** and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD HOLLOW METAL FRAMES

A. **General:** Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. **Exterior Frames**: Fabricated from metallic-coated steel sheet.
1. Fabricate frames with mitered or coped corners.
2. Fabricate frames as face welded unless otherwise indicated.
3. Frames for Level 4 Steel Doors: 14 gauge 0.067-inch- thick steel sheet.

C. **Hardware Reinforcement**: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. **Jamb Anchors**:
1. Post-installed Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

2.6 ACCESSORIES

A. **Mullions and Transom Bars**: Join to adjacent members by welding or rigid mechanical anchors.

B. **Ceiling Struts**: Minimum 1/4-inch-thick by 1-inch- wide steel.

C. **Grout Guards:** Formed from same material as frames, not less than 0.016 inch thick.

2.7 FABRICATION

A. **Fabricate hollow metal work** to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. **Tolerances:** Fabricate hollow metal work to tolerances indicated in SDI 117.

C. **Hollow Metal Doors**:
1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

D. **Hollow Metal Frames**: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
   1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
   2. Provide countersunk, flat- or oval-head exposed screws and bolts for xposed fasteners unless otherwise indicated.
   4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
   5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
   6. Jamb Anchors: Provide number and spacing of anchors as follows:
      a. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
   7. Door Silencers**:** Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
      a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

E. **Fabricate concealed stiffeners**, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

F. **Hardware Preparation:** Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in **Division 8** Section "**Door Hardware**."
   1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
   2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
   3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
   4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.
   5. Provide auxiliary hinge reinforcement at all hinge locations on every frame.

2.9 STEEL FINISHES

A. **Prime Finish:** Apply manufacturer's standard primer immediately after cleaning and pretreating.
   1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

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 embedded and built-in anchors to verify actual locations before frame installation.

C. **For the record, prepare written report,** endorsed by Installer, listing conditions detrimental to performance of the Work.

D. **Proceed with installation** only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. **Remove welded-in shipping spreaders** installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. **Prior to installation**, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
   1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. **Drill and tap doors and frames** to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. **General:** Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. **Hollow Metal Frames**: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
   1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
      a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
      b. Install frames with removable glazing stops located on secure side of opening.
      c. Install door silencers in frames before grouting.
      d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
      e. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
      f. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.
   2. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

3. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. **Hollow Metal Doors**: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
2. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
3. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
4. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

3.4 ADJUSTING AND CLEANING

A. **Final Adjustments:** Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. **Remove grout** and other bonding material from hollow metal work immediately after installation.

C. **Prime-Coat Touchup**: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. **Metallic-Coated Surfaces:** Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

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SECTION 08 3100

ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This **Section includes** the following:
   1. Wall access doors and frames.

B. **Related Sections** include the following:
   1. Section 04 2200 "**Unit Masonry Assemblies**" for anchoring and grouting access door frames set in masonry construction.
   2. Section 08 7140 "**Door Hardware**" for mortise or rim cylinder locks and master keying.

1.3 SUBMITTALS

A. **Product Data**: For each type of 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. **Shop Drawings**: Show fabrication and installation details of customized doors and frames. Include plans, elevations, sections, details, and attachments to other Work.

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.

1.4 QUALITY ASSURANCE

A. **Source Limitations**: Obtain doors and frames through one source from a single manufacturer.

B. **Size Variations**: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.5 COORDINATION

A. **Verification**: Determine specific locations and sizes for access doors needed to gain access to concealed equipment, and indicate on schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. **Available Manufacturers**: Subject to compliance with requirements of Contract Documents, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. J. L. Industries, Inc., part of the Activar Construction Products Group.
   2. Larsen's Manufacturing Company.
   3. Milcor, a division of Hart & Cooley, Inc., a brand of Johnson Controls, Inc.

2.2 MATERIALS

A. **Steel Plates, Shapes, and Bars**: ASTM A 36.

B. **Electrolytic Zinc-Coated Steel Sheet**: ASTM A 591/, Commercial Steel (CS), with Class C coating and phosphate treatment to prepare surface for painting; with minimum thickness indicated representing specified nominal thickness according to ASTM A 568/A 568M for uncoated base metal.

C. **Drywall Beads**: Edge trim formed from 0.0299-inch zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

2.3 PAINT

A. **Shop Primer for Ferrous Metal**: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

2.4 ACCESS DOORS AND FRAMES

A. **Flush Access Doors and Frames with Exposed Trim**: Fabricated from steel sheet.
   1. Locations: Masonry, concrete and ceramic-tile wall surfaces.
   2. Door: Minimum 0.060-inch- thick sheet metal, set flush with exposed face flange of frame.
   3. Frame: Minimum 0.060-inch- thick sheet metal with 1-inch- wide, surface-mounted trim.
   4. Hinges: Continuous piano hinge.
   5. Latch: Screwdriver-operated cam latch.
   6. Lock: Key-operated cylinder lock.

2.5 FABRICATION

A. **General**: Provide access door assemblies manufactured as integral units ready for installation.

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

C. **Steel Doors and Frames**: 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. Exposed Flanges: Nominal 1 to 1-1/2 inches wide around perimeter of frame.
   2. For trimless frames with drywall bead for installation in gypsum board assembly, provide edge trim for gypsum board securely attached to perimeter of frames.
   3. Provide mounting holes in frames to attach frames to framing in drywall construction and to attach masonry anchors in masonry construction. Furnish adjustable metal masonry anchors.

D. **Latching Mechanisms**: Furnish number required to hold doors in flush, smooth plane when closed.
   1. For cylinder lock, furnish two keys per lock and key all locks alike.

2.6 FINISHES, GENERAL

A. **Comply with NAAMM's** "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. **Finish** metal fabrications **after assembly**.

2.7 METALLIC-COATED STEEL FINISHES

A. **Galvanizing of Steel Shapes and Plates**: Hot-dip galvanize items indicated to comply with applicable standard listed below:
   1. ASTM A 153, for galvanizing steel and iron hardware.

B. **Surface Preparation**: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. For galvanized surfaces, apply, after cleaning, a conversion coating suited to the organic coating to be applied over it. For metallic-coated surfaces, clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
   1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

C. **Factory Priming for Field-Painted Finish**: Apply shop primer immediately after cleaning and pretreating.

2.8 STEEL FINISHES

A. **Surface Preparation**: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:
   1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   2. Interiors (SSPC Zone 1A): 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 PREPARATION

A. **Advise installers** of other work about specific requirements relating to access door and floor door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

3.2 INSTALLATION

A. **Comply with manufacturer's written instructions** for installing access doors and frames and floor doors and frames.

B. **Set frames accurately** in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

C. **Install access doors** with trimless frames and floor doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING AND CLEANING

A. **Adjust doors and hardware** after installation for proper operation.

B. **Remove and replace doors and frames** that are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 08 7100

DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. **This Section** includes the following:
   1. Commercial door hardware for swinging doors.

B. **Related Sections** include the following:
   1. Section 08 1110 "**Hollow Metal Doors and Frames**"

1.3 REFERENCED STANDARDS

A. **Provide hardware** in accordance with the following standards in addition to those specified in Division 01 Section “References”.
   1. American National Standards Institute (ANSI), A117.1: Accessible and Usable Buildings and Facilities, edition as adopted by local Authority Having Jurisdiction (AHJ).
   2. Builders Hardware Manufacturer’s Association (BHMA)
      a. ANSI/BHMA A156.2: Bored and Preassembled Locks and Latches, 2011 edition
      b. ANSI/BHMA A156.3: Exit Devices, 2008 edition
      c. ANSI/BHMA A156.4: Door Controls - Closers, 2008 edition
      d. ANSI/BHMA A156.18: Materials and Finishes, 2006 edition
   3. Door and Hardware Institute (DHI)
      a. Recommended Locations for Architectural Hardware for Flush Wood Doors, 1993 edition
      b. Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames, 2004 edition
      c. Installation Guide for Doors and Hardware, 1994 edition
      d. Keying Systems and Nomenclature, 2003 edition
      e. Sequence and Format for the Hardware Schedule, 2001 edition

1.4 SUBMITTALS

A. **Product Data**: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. **Samples for Verification**: For exposed door hardware of each type, in specified finish, full size. Tag with full description for coordination with the door hardware sets. Submit Samples before, or concurrent with, submission of the final door hardware sets, if requested.
   1. Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.

C. **Qualification Data**: For Installer

D. **Product Test Reports**: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for locks, latches, and closers as requested.

E. **Maintenance Data**: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

F. **Warranty**: Special warranty specified in this Section.

G. **Door Hardware Sets**: Prepared by or under the supervision of Architectural Hardware Consultant, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final door hardware sets with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
   1. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
   2. Content: Include the following information:
      a. Identification number, location, hand, fire rating, and material of each door and frame.
      b. Type, style, function, size, quantity, and finish of each door hardware item.
      c. Complete designations of every item required for each door or opening including name and manufacturer.
      d. Fastenings and other pertinent information.
      e. Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
      f. Explanation of abbreviations, symbols, and codes contained in schedule.
      g. Mounting locations for door hardware.
      h. Door and frame sizes and materials.
      i. List of related door devices specified in other Sections for each door and frame.
   3. Submittal Sequence: Submit the final door hardware sets at earliest possible date, particularly where approval of the door hardware sets must precede fabrication of other work that is critical in Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the door hardware sets.

1.5 QUALITY ASSURANCE

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

B. **Architectural Hardware Consultant Qualifications**: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

C. **Source Limitations**: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Inventory door hardware** on receipt and provide secure lock-up for door hardware delivered to Project site.

B. **Tag each item or package separately** with identification related to the final door hardware sets, and include basic installation instructions, templates, and necessary fasteners with each item or package.

C. **Deliver keys to Owner's Representative** by registered mail or overnight package service.

1.7 COORDINATION

A. **Coordinate layout and installation** of recessed hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. **Templates**: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.8 WARRANTY

A. **Special Warranty**: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including excessive deflection, cracking, or breakage.
      b. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three (3) years from date of Substantial Completion, except as follows:
   a. Grade 1 Cylindrical Locks: Ten (10) years from date of Substantial Completion.
   b. Manual Closers: Thirty (30) years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

A. **Maintenance Tools and Instructions**: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1.	Hinges:	Ives, Hager, Stanley, McKinney, Bommer
2.	Locks and Latches:	Schlage, match existing
3.	Cylinders and Cores:	Match Existing
4.	Mechanical Door Closers:	LCN, match existing
5.	Exit Devices:	Von Durpin, match existing
6.	Accessories and Trim:	Ives, Rockwood, Hager, Trimco
7.	Saddle and Panic Thresholds:	Zero, National Guard, Pemko
8.	Weather Strip and Gasket:	Zero, National Guard, Pemko
9.	Miscellaneous Hardware:	Ives, Rockwood, Hager, Trimco

2.2 SCHEDULED HARDWARE

A. **Requirements for design, grade, function, finish, size, and other distinctive qualities** of each type of finish hardware are indicated in the "Hardware Schedule" at the end of this Section. Products are identified by using hardware designation numbers of the following:
   1. Manufacturer's Product Designations: The product designation and name of one manufacturer are listed for each hardware type required for the purpose of establishing minimum requirements. Provide either the product designated or, where more than one manufacturer is specified under the Article "Manufacturers" in Part 2 for each hardware type, the comparable product of one of the other manufacturers that complies with requirements.

2.3 MATERIALS AND FABRICATION

A. **General**

1. Manufacturer's Name Plate: Do not use manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise acceptable to Architect.
   a. Manufacturer's identification will be permitted on rim of lock cylinders only.
2. Base Metals: Produce hardware units of basic metal and forming method indicated using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units for finish designations indicated.
3. Provide hardware manufactured to conform to published templates generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.

B. **Fasteners**

1. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Furnish stainless steel (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.
2. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners. Use through bolts only as indicated in this section unless their use is the only means of reinforcing the work adequately to fasten the hardware securely. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use sex screw fasteners.

2.4 HINGES

A. **Acceptable Products**:

1.	Ives:	5BB1	5BB1HW
2.	Hager:	BB1279	BB1168
3.	Stanley:	FBB179	FBB168
4.	McKinney:	TB2714	T4B3386
5.	Bommer:	BB5000	BB5004

B. **Requirements**:

1. Quantity: Provide the following, unless otherwise indicated:
   a. Two Hinges: For doors with heights up to 60 inches.
   b. Three Hinges: For doors with heights 61 to 90 inches.
2. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
3. Hinge Weight: As indicated in hardware sets.
4. Hinge Base Metal: Unless otherwise indicated, provide the following:
   a. Exterior Hinges: Stainless steel with stainless-steel pin.
   b. Interior Hinges: Steel with steel pin.

5. Hinge Options: Where indicated in door hardware sets or on Drawings:
   a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for out-swinging doors.
   b. Corners: Square.
6. Fasteners: Comply with the following:
   a. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.

2.5 CONTINUOUS HINGES

A. **Acceptable Products**:

1.	Ives:	224HD
2.	Stanley:	662HD
3.	Hager:	780-224HD
4.	Select:	SL24HD
5.	McKinney:	MCK-25HD
6.	Pemko:	FMHD

B. **Requirements**:
1. Geared Continuous Hinges: Shall utilize a single gear section for the door leaf and a separate gear section for the frame side of the door. Provide full mortise or surface applied hinge as scheduled in each set. Geared hinges are to be UL 10C tested and approved for 90 minutes.

2.6 LOCKS AND LATCHES

A. **General**:
1. Lock Chassis: Shall be made from steel, with locking spindles of stainless steel.
2. Latch Bolt: Shall be constructed of stainless steel with 3/4 inch throw on mortise locks and 1/2 inch throw otherwise. Latch to be deadlocking on keyed functions.
3. Lever Trim: Shall be pressure cast brass, bronze, zinc, or steel with wrought rose design. Levers are to be solid with no voids or plastic inserts.
4. Fire Rating: Lock shall be listed for up to 3 hours.
5. Strike Plates: Provide ANSI 4-7/8 inch strike plates. At pairs of doors, provide strike with 7/8 inch flat lip. At single doors, provide round-lipped strike with lip length as required to minimally clear jamb and trim. Provide dust box at each strike location.

B. **Grade 1 Bored Locks**
1. Acceptable Products:
   a. Schlage: ND Series, Rhodes Lever
   b. Match existing facility standard
2. Provide cylindrical locks exceeding the ANSI/BHMA A156.2 Grade 1 performance standards for strength, security & durability in the categories below:
   a. Abusive locked lever torque – minimum 3,100 inch-pounds without gaining access
   b. Offset lever pull - minimum 1,600 foot pounds without gaining access Simulates pry-bar attacks
   c. Vertical lever impact - minimum 100 impacts without gaining access Simulates sledgehammer-blows to trim, very aggressive abuse

d. Cycle life - minimum 16 million cycles Cycle life speaks to robustness of lock, ensuring operation after 10M cycles (BHMA requirement is 1M).
   1) With no visible lever sag Working after 15M cycles is not the same as working well. No droop and wobble means the lock still works like new after the test.
   2) Without the use of performance aids (i.e. set screws, spacers, etc.) Set screws and spacers are a poor fix for droop and wobble. Both add to installation complexity, and set screws can be tamper targets.
e. Door Prep: Provide lockset to install using a standard ANSI 161 door preparation.
f. Anti-Rotation Plate: Provide lockset with a mechanically interlocked anti-rotation plate. Anti-Rotation teeth or “bite tabs” are not acceptable. Locks without any rotation prevention devices are not acceptable.
g. Lever Return Springs: Provide each lever with two compression type return springs that are easily accessible without dismantling the lock chassis. Locks utilizing tension or torsion lever return springs are unacceptable. Locks with internal springs that require dismantling the lock chassis are unacceptable.
h. Lever Spindles: Provide lock with either milled or 1-piece deep drawn spindles. 2-piece interlocking stamped spindles are not acceptable.
i. Multi-Functionality: Provide modular lockset with capability to convert to a new lock function by changing key cams.
j. Vandal Resistant Lever: Where scheduled, provide lockset with lever that freely rotates even when locked to resist vandalism and abuse.

C. **Deadbolts**
1. Requirements:
   a. Provide deadbolts by same manufacturer as the provided locksets.
   b. Provide chassis type, function, and grade as scheduled.

2.7 CYLINDERS AND CORES

A. **Acceptable Products**:
1. Match existing facility standard
2. Keys: Provide cylinder manufacturer’s standard keys. Keys shall be shipped separate from cores directly to owner’s representative. For estimating purposes, provide keys in the following quantities:

a.	Construction Control Keys:	2	each
b.	Construction Change Keys:	12	each
c.	Permanent Control Keys:	2	each
d.	Split Key Voiding Keys:	2	each
e.	Permanent Master Keys:	2	each
f.	Permanent Change Keys:	4	per core

2.8 MECHANICAL DOOR CLOSERS

A. General:
1. Valves: Closers shall have separate valves for latch speed, main speed, and back check. Valves shall be staked to prevent accidental removalProvide the appropriate closer body, handing, and brackets to mount closer inside the building on the least-public side of the door.
   a. Where closers are to be mounted parallel arm, provide with heavy duty, fully forged arms.
   b. Where closers are to be mounted regular arm and the opening can otherwise be opened to 180 degrees, provide closer with the appropriate special templating to allow 180 degree door swing. Where a special template is not available for 180 degree swing, provide closer arm with integrated stop.
2. Integrated Stop Closer Arms: Where a closer with integrated stop is required, provide the appropriate closer and arm as follows:
   a. Parallel arm with spring-cushioned stop arm: Provide where door is otherwise able to open to 95 degrees and requires a parallel arm mount closer.
   b. Parallel arm with dead stop arm: Provide where door is obstructed from opening to 95 degrees and requires a parallel arm mount closer.
   c. Regular arm with push side surface-mounted overhead stop: Provide where door closer should mount on pull side of door.
3. Hold Open Arms: Provide closer arms with mechanical hold-opens as scheduled.
4. Provide closers with any special templates, brackets, plates, or other accessories required for interface with header, door, wall, and other hardware. Provide closers with screw packs containing thru-bolts, machine screws, and wood screws.
5. Closers shall be provided with all-weather fluid and shall not require readjustment from 120 degrees F to -30 degrees F. Fluid shall be non-flaming and shall not fuel door or floor covering fires. Upon request, provide data indicating thermal properties of fluid.
6. Closers shall close and latch door when adjusted to meet accessibility requirements for door opening force: 8.5 lbs at exterior doors, 5 lbs at interior doors, and 15 lbs at labeled fire doors.

B. **Heavy Duty Door Closers**:
1. Acceptable Products:
   a. LCN: 4040XP
   b. Match existing facility standard
2. Requirements:
   a. ANSI Grade: BHMA/ANSI A156.4, Grade 1.
   b. Closer Construction: Closer shall have cast iron or aluminum alloy body with 1-1/2 inch steel piston, double heat treated pinion, 5/8 inch bearing journals, and full complement needle or caged ball bearings. Closer shall be adjustable from sizes 1 through 6.
   c. Provide closers with spring size adjustment dial for ease of adjusting.

2.9 EXIT DEVICES

A. Acceptable Products:
1. Von Duprin: 98/35A Series
2. Match existing facility standard

B. **Requirements**:

1. ANSI Grade: BHMA/ANSI A156.3, Grade 1.
2. Device Construction:
   a. Exit device(s) shall have a mechanism case constructed of extruded, base plates constructed of cast steel, push pad of extruded aluminum with stainless steel covering, and end caps with flush mounted, sloped design. At full-glass doors, provide exit devices with no exposed fasteners or rivets visible through glass. Where required by stile width, provide narrow-stile type device.
   b. Latchbolt: Provide Pullman-type deadlocking latch bolts constructed of stainless steel. Where specified provide high security Pullman-type latchbolt that collapses to be square faced under high pull forces. Latch return springs shall be compression type. Tension and Torsion latch return springs are not acceptable.
   c. Dogging Mechanism: where dogging or latch-retraction options are not specifically scheduled for non-fire rated doors, provide device with cylindrical dogging. Plastic or nylon used for the push pad, or parts in the dogging mechanism or latchbolt mechanism are unacceptable.
   d. Sound Dampening: Device shall be provided with factory-installed sound dampening materials.
   e. Provide device type, function, and trim style as indicated in hardware schedules.
3. Where exit device(s) are provided for fire rated door, provide with fire listing and label indicating “Fire Exit Hardware”. If device is mounted on wood doors, provide sex nuts and bolts.
4. Provide shim kits, filler plates, and other accessories as required for each opening.
5. Unless otherwise indicated in the sets, provide device with roller-type strike.
6. Where scheduled, provide removable mullions by same manufacturer as provided exit devices. Provide mullion stabilizers, key removable option, strike preps, and fire rating as indicated in sets.
7. Concealed vertical exit devices shall be a cable-actuated concealed vertical latch system available in two-point and less bottom latch (LBL) configurations. Vertical rods are not acceptable.
   a. Cable shall include color-coded stainless steel with polytetrafluoroethylene (Teflon®) liner and stainless steel core wire. Latches and center slides are color coded to aid in installation. Conduit and core wire ends snap into latch and center slides without the use of tools. Latchbolts and blocking cams shall be manufactured from sintered metal low carbon copper- infiltrated steel, with a molybdenum disulfide coating for low friction and consistent performance.
   b. Top latchbolt shall have a minimum 0.382 inch and greater than 90 degree engagement with strike to prevent door and frame separation under high static load. Bottom latchbolt, when used, shall have a minimum of 0.44 inch engagement with strike.
   c. Product cycle life shall exceed 1,000,000 cycles.
   d. Latch release does not require separate trigger mechanism.
   e. Top and bottom latch must operate independently of each other. Top latch will fully engage top strike even when bottom latch is compromised.
   f. Cable and latching system shall have the ability to:
      1) Be assembled as a complete assembly and function prior to being installed in the door.
      2) Install into the door as a one-piece single assembly
      3) Be installed independently of device installation and function on door even prior to device and trim installation.
      4) Connect to the exit device at a single attachment point.

5) Adjust bottom latch height from a single point, after the system is installed and connected to exit device, while the door is hanging
6) Alter latch position up and down within two-inches without additional adjustment.
7) Ability to remove the system while door is hanging.
8) Configure latchbolt mounting: double or single tab mount for steel doors, and wood doors, face mount for aluminum doors, eliminating requirement of tabs.
9) Provide adjustable exit device to latch center line adjustment. Ensures double tab mounting option for top latch, regardless of exit device centerline.

2.10 ARCHITECTURAL DOOR TRIM

A. **Protection Plates and Edge Guards**
1. Acceptable Products:
   a. Ives: 8400 Series
   b. Rockwood: K1050
   c. Hager: 194S
   d. Trimco: K Series
2. Requirements:
   a. Provide .050 inch thick stainless steel protection plates with height as scheduled. Plate shall have four beveled edges and countersunk screws. Provide plate with width as follows:
      1) Pairs of Doors: Provide plate to be 1 inch less door width.
      2) Single Doors: Provide plate to be 2 inches less door width on push side, pull side mounted plates to be 1 inch less door width.
      3) Where Specified with Edge Guards: Provide plate to be 2 inches less door width.

B. **Door Stops and Holders**
1. Acceptable Products:
   a. Ives: WS407
   b. Rockwood: 405/406
   c. Hager: 236W
   d. Trimco: 1270
2. Requirements:
   a. Provide stops and holders as indicated in the HW sets.
   b. Where wall bumpers are scheduled, provide concave rubber bumper where the adjacent lever trim incorporates a push-button. Otherwise, provide convex rubber bumpers.

2.11 SADDLE AND PANIC THRESHOLDS

A. **Acceptable Products**:
1. Zero International: 655A
2. National Guard: 425HD
3. Pemko: 1715A

B. **Requirements**:
1. Saddle thresholds: Provide with length equal to the width of the opening.
2. Panic thresholds: Provide with length equal to the overall frame width. Provide with mitered and welded ends.
3. Provide stainless steel machine screws and lead anchors for each threshold.

2.12 WEATHERSTRIP AND GASKET

A. **General**:
1. Provide weather strip and gasketing as scheduled.
2. Size weather strip and gasket to provide a continuous seal around opening and at meeting stiles.

B. **Perimeter Seals**
1. Acceptable Products:
   a. Zero: 429A
   b. National Guard: 700SA
   c. Pemko: 2891AS

C. **Astragals, Meeting Stiles, and Mullion Seals**
1. Acceptable Products:
   a. Zero: 155AA X 55A
   b. National Guard: 9605A
   c. Pemko: 18041CNB
2. Requirements
   a. Where overlapping astragals are scheduled on exterior doors, provide with thru-bolts.

D. **Door Bottoms**
1. Acceptable Products:
   a. Zero: 39A
   b. National Guard: 200A

2.13 MISCELLANEOUS HARDWARE

A. **Silencers**
1. Acceptable Products:
   a. Ives: SR64
   b. Rockwood: 608
   c. Hager: 307D
   d. Trimco: 1229A
2. Requirements:
   a. Where indicated on single openings, provide 3 each rubber silencers on lock jamb.
   b. Where indicated on paired openings, provide 2 each rubber silencers on header.

2.14 HIGH SECURITY EMERGENCY KEY BOX

A. **Acceptable Products**:
1. Knox, Inc. 3200 Series x RMK
2. Substitutions as approved by Architect/Owner

B. **Requirements**:
1. Provide recess-mounted emergency key box as approved by the local fire jurisdiction. Key box to be master-keyed as dictated by local fire jurisdiction.

2.15 FINISHES

A. **Match items to the manufacturer's standard color and texture finish** for the latch and locksets (or push-pull units if no latch or locksets).

B. **Provide quality of finish**, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

C. **The designations used in schedules and elsewhere** to indicate hardware finishes are those listed in ANSI/BHMA A156.18, "Materials and Finishes," including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.

D. **The designations used in schedules and elsewhere** to indicate hardware finishes are the industry-recognized standard commercial finishes, except as otherwise noted.
   1. Brushed Chrome and/or Stainless Steel Appearance
      a. Brushed Stainless Steel, no coating: ANSI 630.
      b. Satin Chrome, Clear Coated: ANSI 626, ANSI 652.
      c. Powder Coated Aluminum finish: ANSI 689.
      d. Saddle and Panic Thresholds: Mill Aluminum finish.
      e. Weatherstrip and Gasket: Clear Anodized Aluminum finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Examine doors and frames**, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. **Proceed with installation only after** unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 INSTALLATION

A. **Pre-installation conference** shall be conducted prior to installation of hardware at Project site. Meet with the, Owner, Contractor, installer, and manufacturer’s representatives. A separate pre-installation conference shall be conducted prior to the installation of electronic security hardware with the electrical contractor Review catalogs, brochures, templates, installation instructions, and the approved hardware schedule. Survey installation procedures and workmanship, with special emphasis on unusual conditions, as to ensure correct technique of installation, and coordination with other work. Notify participants at least ten, 10 working days before conference.

B. **Hardware Installers** must have a minimum of five (5) years’ experience in installation of hardware. Provide verification of installer’s qualification to Consultant for approval. All installers to attend review meetings with the hardware distributor.

C. **Install hardware using only manufacturer supplied and approved fasteners** in strict adherence with manufacturers published installation instructions.

D. **Install head seal** prior to installation of “PA”-parallel arm mounted door closers and push side mounted door stops/holders. Trim, cut and notch thresholds and saddles neatly to minimally fit the profile of the door frame. Install thresholds and saddles in a bed of caulking completely sealing the underside from water and air penetration.

E. **Counter sink through bolt** of door pull under push plate during installation.

F. **Mounting Heights**: Mount door hardware units at heights indicated, as follows, unless otherwise indicated or required to comply with governing regulations.
1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Custom Steel Doors and Frames: DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."
3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

G. **Install each door hardware item** to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

H. **Thresholds**: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

3.4 FIELD QUALITY CONTROL

A. **Architectural Hardware Consultant**: Architect shall engage a qualified Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

B. **Architectural Hardware Consultant shall inspect** door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

A. **Initial Adjustment**: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
1. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

B. **Occupancy Adjustment**: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

A. **Clean adjacent surfaces** soiled by door hardware installation.

B. **Clean operating items** as necessary to restore proper function and finish.

C. **Provide final protection** and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DEMONSTRATION

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

3.8 DOOR HARDWARE SETS

A. **The following schedule of hardware sets** shall be considered a guide and the supplier is cautioned to refer to general conditions, special conditions, and the full requirements of this section. It shall be the hardware supplier's responsibility to furnish all required hardware.

B. **Where items of hardware** are not definitely or correctly specified and are required for completion of the Work, a written statement of such omission, error, conflict, or other discrepancy shall be sent to the Architect, prior to date specified for receipt of bids, for clarification by addendum.

C. **Adjustments to the Contract Sum will not be allowed** for omissions or items of hardware not clarified prior to bid opening.

HW SET NO: 01 - Not Used

HW SET NO: 02 - Not Used

HW SET NO: 03 - Not Used

HW SET NO: 04 - Not Used

HW SET NO: 05 - Not Used

HW SET NO: 06
DOOR NUMBER: (Includes but is not limited to the following doors)
110 111

3 EA	HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
1 EA	KEYED PRIVACY WITH INDICATOR	L9056L 06B L583-363 L283-722	626	SCH
1 EA	MORTISE CYLINDER	MATCH EXISTING	626	TBD
1 EA	SURFACE CLOSER	4040XP SCUSH SRI TBWMS	689	LCN
1 EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
3 EA	SILENCER	SR64	GY	IVE

HW SET NO: 07 - Not Used

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DIVISION 9 - FINISHES

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SECTION 09 3000

CERAMIC TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This **Section includes** the following:
1. Porcelain floor tile.
2. Glazed wall tile.
3. Waterproofing for tile installations.
4. Thresholds installed with tile system.

B. **Related Sections** include the following:
1. Section 03 3000 "**Cast-in-Place Concrete**" for monolithic slab finishes specified for tile substrates.
2. Section 07 9200 "**Joint Sealants**" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

1.3 DEFINITIONS

A. **Module Size**: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.

B. **Facial Dimension**: Nominal tile size as defined in ANSI A137.1.

C. **Movement Joints**: Include the following types of joints: Cold Joint, Construction Joint, Contraction Joint, Control Joint, Expansion Joint and Isolation Joint.

1.4 PERFORMANCE REQUIREMENTS

A. **Static Coefficient of Friction**: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
1. Level Surfaces: Minimum 0.6.

B. **Load-Bearing Performance**: For ceramic tile installed on walkway surfaces, provide installations rated for the following load-bearing performance level based on testing assemblies according to ASTM C 627 that are representative of those indicated for this Project:
1. Heavy: Passes cycles 1 through 12.

1.5 SUBMITTALS

A. **Product Data**: For each type of tile, mortar, grout, and other products specified.

B. **Shop Drawings**: Submit shop drawings showing location of each tile and installation method. Include movement joint locations, trim type and size.

C. **Tile Samples for Selection**: Manufacturer's color charts consisting of actual tiles or sections of tiles showing the full range of colors, textures, and patterns available for each type and composition of tile indicated. Include Samples of accessories involving color selection.

D. **Grout Samples for Selection**: Manufacturer's color charts consisting of actual sections of grout showing the full range of colors available for each type of grout indicated.

1.6 QUALITY ASSURANCE

A. **Installer Qualifications**: Engage an experienced installer who has completed tile installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. **Source Limitations for Tile**: Obtain each color, grade, finish, type, composition, and variety of tile from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties without delaying the Work.

C. **Source Limitations for Setting and Grouting Materials**: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

D. **Source Limitations for Other Products**: Obtain each of the following products specified in this Section from one source and by a single manufacturer for each product:
1. Solid surface material thresholds.
2. Waterproofing.

E. **Movement Joints**: Provide movement joints as recommended by TCNA EJ171-09 "Movement Joint Design Essentials". Space joints as recommended by TCNA method, coordinate with the Architect for precise location of joints.
1. Align with any cold joints or other movement joints provided by other trades.
2. Interior Joints exposed to direct sunlight or moisture: 8 to 12 feet in each direction.
3. Perimeter Joint: Where tile abuts restraining surfaces such as perimeter walls, columns, stairs and curbs.

1.7 DELIVERY, STORAGE, AND HANDLING

A. **Deliver and store** packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.

B. **Prevent damage** or contamination to materials by water, freezing, foreign matter, and other causes.

C. **Handle tile** with temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT CONDITIONS

A. **Environmental Limitations**: Do not install tile until construction in spaces is completed and ambient temperature and humidity conditions are being maintained to comply with referenced standards and manufacturer's written instructions.

1.9 EXTRA MATERIALS

A. **Deliver extra materials to Owner**. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
   1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

PART 2 - PRODUCTS

2.1 TILE MANUFACTURERS

A. **Basis of Design:** Contract Documents are based on products specified below to establish a standard of quality. Other manufacturers with products having equivalent characteristics may be considered provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.
   1. **Manufacturer/Supplier**: Daltile.
   2. Products:
      a. Floor: Keystones.
      b. Wall: Modern Dimensions.

B. **Substitutions:** Submit products other than the "Basis of Design" as a substitution, according to Conditions of the Contract and Division 1 Sections.

2.2 TILE-SETTING AND -GROUTING MATERIALS

A. **Available Manufacturers**: Subject to compliance with requirements (including color and texture as indicated in Finish Schedule), manufacturers offering products that may be incorporated into the Work include the following:
   1. **Custom** Building Products
   2. **Laticrete** International, Inc.
   3. **Mapei** Corporation.

2.3 PRODUCTS, GENERAL

A. **ANSI Ceramic Tile Standard**: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
   1. Provide tile complying with Standard Grade requirements, unless otherwise indicated.
   2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.

B. **ANSI Standards for Tile Installation Materials**: Provide materials complying with ANSI standards referenced in "Setting Materials" and "Grouting Materials" articles.

C. **Colors, Textures, and Patterns**: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:
   1. Provide products indicated in the Finish Schedule.
   2. Where a Finish Schedule is not provided or does not indicate a specific product, provide selections from manufacturer's full range of colors, textures, and patterns for products of type indicated.
   3. Provide tile trim and accessories that match color and finish of adjoining flat tile.

D. **Factory Blending**: For tile exhibiting color variations within the ranges selected during Sample submittals, blend tile in the factory and package so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples.

E. **Mounting**: Where factory-mounted tile is required, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless another mounting method is indicated.
   1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for these kinds of installations and has a record of successful in-service performance.

F. **Factory-Applied Temporary Protective Coating**: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating them with a continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.4 TILE PRODUCTS

A. **Porcelain Ceramic Mosaic Floor Tile**: Provide factory-mounted flat tile complying with the following requirements:
   1. Composition: Porcelain.
   2. Module Size (nom.): As indicated on Finish Schedule.
   3. Nominal Thickness: 1/4 inch.
   4. Face: Matte finish with square edges; "natural".
   5. Colors: As listed in the Legend-Finish Schedule or if not listed then as selected by Architect from manufacturer's full range.

B. **Glazed Ceramic Wall Tile**: Provide flat tile complying with the following requirements:
   1. Field Tile: Module size - 4-1/4 x 8-1/2 inches (nominal).
   2. Thickness: 5/16 inch.
   3. Face: Plain with cushion edges.
   4. Colors: As listed in the Legend-Finish Schedule on the Drawings or, if not listed, as selected by Architect from manufacturer's full range.

C. **Trim Units**: Provide tile trim units to match characteristics of adjoining flat tile and to comply with the following requirements:
   1. Size: As indicated, coordinated with sizes and coursing of adjoining flat tile where applicable.
   2. Shapes: As follows, selected from manufacturer's standard shapes:
      a. Base for Portland Cement Mortar Installations: Coved, flush.
      b. Base for Thin-Set Mortar Installations: Straight.
      c. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose.
      d. External Corners for Thin-Set Mortar Installations: Surface bullnose.
      e. Internal Corners: Field-butted square corners, except with coved base and cap angle pieces designed to member with stretcher shapes.

2.5 THRESHOLDS

A. **General**: Provide thresholds that are uniform in color and finish, fabricated to sizes and profiles indicated to provide transition between tile surfaces and adjoining finished floor surfaces.
   1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch (12.7 mm) or less above adjacent floor surface.

B. **Marble Thresholds**: ASTM C 503, with a minimum abrasion resistance of 12 per ASTM C 1353 or ASTM C 241 and with honed finish.
   1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.6 FLUID APPLIED WATERPROOFING AND CRACK ISOLATION MEMBRANE

A. **Available Manufacturers**: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include but are not limited to the following:
   1. Manufacturer: Mer-Krete, a Division of Parexlaharba.
   2. Product: Hydro-Guard 2000
      a. Provide a Type II synthetic reinforcement cloth.

B. **Fluid Applied Membrane Properties:**
   1. Elongation: 500 percent**,** minimum; over crack: 0.22 inches (Split Slab Test).
   2. Water Head Resistance: 115 feet for a period of sixty minutes without water transmission or rupture of the membrane.
   3. Thickness: 30 mils, minimum.
   4. Adhesion in Shear: 250 psi or greater.
   5. Tensile Strength: 450 psi
   6. Tile Adhesion to Membrane: 500 psi, minimum.
   7. Freeze Thaw cycle after cure - 250 cycles. No Change (M/K A-223) method.
   8. Membrane: ICBO listed, meeting ANSI A-118.10 Standard.
   9. Joint Backing: Closed cell polyethylene.
   10. Sealant: Single or two component urethane per TCNA requirements.

2.7 METAL JOINT TRIM

A. **Acceptable Manufacturer:** Subject to compliance with requirements of Contract Documents, provided products by manufacturer listed below. If not listed, submit as substitution according to Conditions of the Contract and the provisions of Division 1 Sections.
   1. **Schluter Systems**; www.schluter.com.

B. **Finish:** Satin nickel anodized aluminum.

C. **Shapes:** As indicated in Finish Schedule and below:
   1. Edge Trim: SCHIENE.
   2. Expansion Joints: DILEX – EDP.

2.8 SETTING MATERIALS

A. **Latex-Portland Cement Mortar:** ANSI **A118.4**, composed as follows:
   1. **Mixture of Dry-Mortar Mix and Latex Additive**: Mixture of prepackaged dry-mortar mix and liquid-latex additive complying with the following requirements:
      a. Basis of Design (Thin set installations): Laticrete 3701 or Mapei Kerabond/Keralastic.
      b. Basis of Design (Thick set installations): Laticrete 226 with 3701 additive.
      c. Latex Additive: Styrene butadiene rubber.
      d. For wall applications, provide nonsagging, latex-Portland cement mortar complying with ANSI A118.4 for mortar of this type defined in Section F-2.1.2.
      e. Protection:
         1) Install only at temperatures between 40 degrees F and 95 degrees F.
         2) Protect from traffic for 24 hours. Protect from heavy traffic for 7 days.
         3) Protect from frost and rain for 21 days.
         4) Protect from water immersion for 21 days.

2.9 GROUTING MATERIALS

A. **Latex-Portland Cement Grout**: ANSI A118.6 for materials described in Section H-2.4, composed as follows:
   1. Mixture of Dry-Grout Mix and Latex Additive: Mixture of factory-prepared, dry-grout mix and latex additive complying with the following requirements:
      a. Unsanded Dry-Grout Mix: Dry-set grout complying with ANSI A118.6 and ISO CG2WA (cementitious grout (CG), improved (2), with reduced water absorption (W) and high abrasion resistance (A)) , for joints 1/8 inch (3.2 mm) and narrower.
         1) Basis of Design: Mapei "Keracolor U".
         2) Stain Resistant Additive: Mapei "Grout Maximizer" in lieu of water as recommended by manufacturer.
         3) Protection:
            (a) Use only at temperatures between 50 deg. F and 100 deg. F.
            (b) At showers and tub surrounds, restrict use for 48 hours; at steam showers, restrict use for 14 days.
            (c) Keep installation from immersion in water and protect from rain and freezing for at least 21 days after completion.
            (d) Floors: Keep free from heavy traffic for at least 3 hours after grouting.
            (e) Walls: Protect from impact, vibration, and hammering on adjacent and opposite walls for 14 days after tile installation.
            (f) Allow for extended periods of cure and protection when temperatures drop below 60 degrees F or when the relative humidity is higher than 70 percent.

b. **Sanded Dry-Grout Mix**: Commercial Portland cement grout complying with ANSI A118.6 and ISO CG2WA (cementitious grout (CG), improved (2), with reduced water absorption (W) and high abrasion resistance (A)), for joints 1/8 inch (3.2 mm) and wider.
   1) Basis of Design: Mapei "Keracolor S".
   2) Stain Resistant Additive: "Grout Maximizer" in lieu of water (or as recommended by grout manufacturer).
   3) Protection:
      (a) Use only at temperatures between 50 deg. F and 100 deg. F.
      (b) At showers and tub surrounds, restrict use for 48 hours; at steam showers, restrict use for 14 days.
      (c) Keep installation from immersion in water and protect from rain and freezing for at least 21 days after completion.
      (d) Floors: Keep free from heavy traffic for at least 3 hours after grouting.
      (e) Walls: Protect from impact, vibration, and hammering on adjacent and opposite walls for 14 days after tile installation.
      (f) Allow for extended periods of cure and protection when temperatures drop below 60 deg. F or when the relative humidity is higher than 70 percent.

c. **Colors**: As selected by Architect from manufacturer's full range of colors.

2.10 ELASTOMERIC SEALANTS

A. **General**: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements of Division 7 Section "Joint Sealants."

B. **Colors**: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

C. **One-Part, Mildew-Resistant Silicone Sealant**: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and temperature extremes.

D. **Multipart, Pourable Urethane Sealant for Use T**: ASTM C 920; Type M; Grade P; Class 25; Uses T, M, A, and, as applicable to joint substrates indicated, O.

E. **Available Products**: Subject to compliance with requirements, products which may be incorporated into the Work include, but are not limited to, the following:
   1. **One-Part, Mildew-Resistant Silicone Sealants**:
      a. Dow Corning 786; Dow Corning Corporation.
      b. Sanitary 1700; GE Silicones.
      c. Pecora 898 Sanitary Silicone Sealant; Pecora Corp.
      d. Tremsil 600 White; Tremco, Inc.
   2. **Multipart, Pourable Urethane Sealants**:
      a. Chem-Calk 550; Bostik.
      b. Vulkem 245; Mameco International, Inc.
      c. NR-200 Urexpan; Pecora Corp.
      d. THC-900; Tremco, Inc.

2.11 MISCELLANEOUS MATERIALS

A. **Trowelable Underlayments and Patching Compounds**: Latex-modified, Portland-cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. **Metal Edge Strips**: White-zinc-alloy terrazzo strips, 1/8 inch (3.2 mm) wide at top edge with integral provision for anchorage to mortar bed or substrate, unless otherwise indicated.

C. **Temporary Protective Coating**: Provide product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; is compatible with tile, mortar, and grout products; and is easily removable after grouting is completed without damaging grout or tile.
   1. **Petroleum paraffin wax**, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 degrees F (49 to 60 degrees C) per ASTM D 87.

D. **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.

E. **Grout Sealer**: Solvent-based, no-sheen, natural-look penetrating sealer for all sanded and non-sanded grout joints.

2.12 MIXING MORTARS AND GROUT

A. **Mix mortars** and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. **Add materials and additives in accurate proportions**. Do not use or add any water to mortar or grout when mixing, use only latex additive.

C. **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, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
   1. Verify that substrates for setting tile are firm; dry; clean; free from oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 series of tile installation standards for installations indicated.
   2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
   3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust latter in consultation with Architect.

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

3.2 PREPARATION

A. **Remove coatings**, including curing compounds, and other substances that contain soap, wax, oil, or silicone and are incompatible with tile-setting materials by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.

B. **Provide concrete substrates** for tile floors installed with dry-set or latex-Portland cement mortars that comply with flatness tolerances specified in referenced ANSI A108 series of tile installation standards for installations indicated.
   1. Use trowelable leveling and patching compounds per tile-setting material manufacturer's written instructions to fill cracks, holes, and depressions.
   2. Remove protrusions, bumps, and ridges by sanding or grinding.

C. **Blending**: For tile exhibiting color variations within the ranges selected during Sample submittals, verify that tile has been blended in the factory and packaged so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

D. **Field-Applied Temporary Protective Coating**: Where indicated under tile type or needed to prevent adhesion or staining of exposed tile surfaces by grout, protect exposed surfaces of tile against adherence of mortar and grout by precoating them with a continuous film of temporary protective coating indicated below, taking care not to coat unexposed tile surfaces:
   1. Petroleum paraffin wax, applied hot.

3.3 INSTALLATION, GENERAL

A. **ANSI Tile Installation Standards**: Comply with parts of ANSI A108 series of tile installation standards in "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.

B. **TCNA Installation Guidelines**: TCNA's "Handbook for Ceramic Tile Installation." Comply with TCNA installation methods indicated in ceramic tile installation schedules.

C. **Extend tile work into recesses** and under or behind equipment and fixtures to form a complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

D. **Accurately form intersections and returns**. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

E. **Jointing Pattern**: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are the same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.
   1. For tile mounted in sheets, make joints between tile sheets the same width as joints within tile sheets so joints between sheets are not apparent in finished work.

F. **Lay out tile wainscots** to next full tile beyond dimensions indicated.

G. **Movement Joints**: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated or if not indicated as recommended by TCNA guidelines, during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
1. Locate joints in tile surfaces directly above joints in concrete substrates.
2. Locate joints as indicated on Drawings or, if not indicated, in accordance with the following spacings:

Environment	Minimum	Maximum	Joint Width
Interior	16 feet	20 feet	1/4 inch
Interior/Sunlight	8 feet	12 feet	1/4 inch

3. Prepare joints and apply sealants to comply with requirements of Division 7 Section "Joint Sealants" where noted on Drawings. Other joints, provide with metal trims as noted above.

H. **Grout tile to comply** with the requirements of the following tile installation standards:
1. **For ceramic tile grouts** (sand-Portland cement, dry-set, commercial Portland cement, and latex-Portland cement grouts), comply with ANSI A108.10.

3.4 FLOOR TILE INSTALLATION

A. **General**: Install tile to comply with requirements in the Ceramic Tile Floor Installation Schedule, including those referencing TCNA installation methods and ANSI A108 series of tile installation standards.
1. **Installation Methods**:
   a. Tile over Concrete Surfaces in Shower Areas: TCNA B421.
      1) Waterproof membrane meeting ANSI A118.10.
      2) Mortar meeting ANSI A108.1A.
   b. Tile over Concrete Surfaces: TCNA F125Full.

B. **Joint Widths**: Install tile on floors with the following joint widths:
1. Porcelain Mosaic Tile: 1/8 inch.

C. **Back Buttering**: For installations indicated, obtain 100 percent mortar coverage by complying with applicable special requirements for back buttering of tile in referenced ANSI A108 series of tile installation standards:
1. Tile floors composed of tiles 8 by 8 inches or larger.
2. Tile floors installed with chemical-resistant grouts.

D. **Marble Thresholds**: Install marble thresholds at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise indicated.
1. Set thresholds in latex-Portland cement mortar for locations where mortar bed would otherwise be exposed above adjacent nontile floor finish.

E. **Metal Edge Strips**: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

F. **Apply two (2) coats of grout sealer** in accordance with manufacturer's printed instructions and recommendations. Remove sealer remaining on the tile within 3 to 5 minutes of application.

3.5 WALL TILE INSTALLATION

A. **Install** types of tile designated for wall installations to comply with requirements in the Ceramic Tile Wall Installation Schedule, including those referencing TCNA installation methods and ANSI setting-bed standards.
   1. **Installation Methods**:
      a. Tile over Masonry Surfaces: TCNA W211 (where required to flatten or true walls)
      b. Tile for Showers: TCNA B421.

B. **Joint Widths**: Install tile on walls with the following joint widths:
   1. Ceramic Tile: 1/16 inch.
   2. Wall Tile: 1/16 inch.

C. **Back Buttering**: For installations indicated, obtain 100 percent mortar coverage by complying with applicable special requirements for back buttering of tile in referenced ANSI A108 series of tile installation standards:
   1. Tile wall installations in wet areas, including showers.
   2. Tile wall installations composed of tiles 8 by 8 inches or larger.

D. **Apply two (2) coats of grout sealer** in accordance with manufacturer's printed instructions and recommendations. Remove sealer remaining on the tile within 3 to 5 minutes of application.

3.6 CLEANING AND PROTECTING

A. **Cleaning**: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
   1. Remove latex-Portland cement grout residue from tile as soon as possible.
   2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.
   3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to brick and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

B. **Finished Tile Work**: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.

C. **Provide final protection** and maintain conditions, in a manner acceptable to manufacturer and Installer, which ensure tile is without damage or deterioration at the time of Substantial Completion.

D. **When recommended by tile manufacturer**, apply a protective 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.

E. **Prohibit foot and wheel traffic** from tiled floors for at least 7 days after grouting is completed.

F. **Before final inspection**, remove protective coverings and rinse neutral cleaner from tile surfaces.

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SECTION 09 6513

RESILIENT WALL BASE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This **Section includes** the following:
   1. Resilient wall base.

1.3 SUBMITTALS

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

B. **Samples for Initial Selection**: For each type of product indicated. Manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long, of each resilient product color and pattern required

C. **Maintenance Data**: For resilient products to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. **Fire-Test-Response Characteristics**: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. **Store resilient products and installation materials in dry spaces** protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 degrees F (10 degrees C) or more than 90 degrees F (32 degrees C). Store tiles on flat surfaces.

1.6 PROJECT CONDITIONS

A. **Maintain temperatures within range recommended by manufacturer**, but not less than 70 degrees F (21 degrees C) or more than 95 degrees F (35 degrees C), in spaces to receive floor tile during the following time periods:
   1. 48 hours before installation.
   2. During installation.
   3. 48 hours after installation.

B. **After post-installation period**, maintain temperatures within range recommended by manufacturer, but not less than 55 degrees F or more than 95 degrees F .

C. **Close spaces to traffic during** floor covering **installation**.

D. **Close spaces to traffic for 48 hours after** floor covering **installation**.

E. **Install resilient products after other finishing operations**, including painting, have been completed.

1.7 EXTRA MATERIALS

A. **Furnish extra materials** described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Resilient Wall Base: Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 RESILIENT WALL BASE - RUBBER

A. **Basis of Design:** Contract Documents are based on product specified below to establish a standard of quality. Other manufacturers offering products with equivalent characteristics may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.
   1. Manufacturer: Roppe.
   2. Product: Pinnacle

B. **Properties:** ASTM F 1861
   1. Type (Material Requirement): TS (rubber, thermoset).
   2. Group (Manufacturing Method): I (solid, homogeneous).
   3. Style - Standard: Coved.
   4. Minimum Thickness: 0.125 inch.
   5. Height: 4 inches.
   6. Lengths: Coils in manufacturer's standard length.
   7. Outside Corners: Pre-molded.
   8. Inside Corners: None.
   9. Surface: Smooth.
   10. Colors**:** As indicated on Legend-Finish on Drawings or, if not indicated, as selected by Architect from manufacturer's full range.

2.2 INSTALLATION MATERIALS

A. **Adhesives:** Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Examine substrates**, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
   1. Verify finishes of substrates comply with tolerances and other requirements specified in other Sections and substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. **Prepare substrates** according to manufacturer's written recommendations to ensure adhesion of resilient products.

B. **Concrete Substrates**: Prepare according to ASTM F 710.
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
   3. Moisture Testing:
      a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
      b. Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

C. **Remove substrate coatings and other substances that are incompatible** with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

D. **Use trowelable leveling and patching compound** to fill cracks, holes, and depressions in substrates.

E. **Move resilient products and installation materials into spaces** where they will be installed at least 48 hours in advance of installation.
   1. Do not install resilient products until they are same temperature as space where they are to be installed.

F. **Sweep and vacuum clean substrates** to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 RESILIENT WALL BASE INSTALLATION

A. **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.

B. **Install wall base in lengths as long as practicable** without gaps at seams and with tops of adjacent pieces aligned.

C. **Tightly adhere wall base to substrate** throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

D. **Do not stretch wall base** during installation.

E. **On masonry surfaces or other similar irregular substrates**, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.

F. **Pre-molded Corners**: Install pre-molded corners before installing straight pieces.

3.4 CLEANING AND PROTECTION

A. **Perform the following operations immediately after** completing resilient product installation:
   1. Remove adhesive and other blemishes from exposed surfaces.
   2. Sweep and vacuum surfaces thoroughly.
   3. Damp-mop surfaces to remove marks and soil.
      a. Do not wash surfaces until after time period recommended by manufacturer.

B. **Protect resilient products** from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer..

END OF SECTION

SECTION 09 9123

PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. **Section includes** painting work, **interior** and **exterior**. Work includes, but is not limited to painting the following:
   1. Exterior steel.
   2. Exterior concrete where indicated on Drawings.
   3. Metal doors and metal door frames.
   4. Exterior metal mechanical units, grilles and louvers.
   5. Interior walls and ceilings.
   6. Interior steel rails and misc. metal.
   7. Exterior exposed metal flashing.
   8. Interior and exterior masonry. (See Division 7 for exterior water repellents.)
   9. Work includes field painting of exposed bare and covered pipes and ducts (including color coding), and of hangers, exposed steel and iron work, plug mold, electric panels, and primed metal surfaces of equipment installed under mechanical and electrical work, except as otherwise indicated.

B. **Related Sections:**
   1. Section 09 0000 **"Finish Selection"** for product selections and colors.
   2. **Shop Primers**: Unless otherwise specified, shop priming of ferrous metal items is included under various sections for structural steel, metal fabrications, hollow metal work and similar items.
      a. Unless otherwise specified, shop priming of fabricated components such as architectural woodwork, wood casework and shop-fabricated or factory-built mechanical and electrical equipment or accessories is included under other sections of these specifications.
      b. Comply with PDCA Standard P15 “Painting of Shop Primed Substrates”

C. "**Paint**" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

D. **Gloss and Sheen Definitions** shall determine the equivalency of the desired finish luster when described in the construction documents by a traditional name instead of gloss units due to the wide variance of sheen descriptions available from manufacturer to manufacturer. Gloss shall be determined by ASTM D523 - 08 Standard Test Method for Specular Gloss.
   1. Flat: Refers to a lusterless or matte finish with a gloss range below 5 units when measured with a 60 degree meter and no more than 10 units measured at an 85 degree meter.
   2. Low-Sheen: Refers to a velvet-like finish with a gloss range below 10 units when measured with a 60 degree meter and between 10-35 units measured at an 85 degree meter.

3. Satin: Refers to low-to-medium range finish with a gloss range between 20-35 units when measured with a 60 degree meter and at least 35 units measured at an 85 degree meter.
4. Semi-Gloss: Refers to a medium sheen finish with a gloss range between 35-70 units when measured with a 60 degree meter.
5. Gloss: Refers to a high sheen finish with a gloss range between 70-85 units when measured with a 60 degree meter.
6. High-Gloss: Refers to a very high sheen finish with a gloss range more than 85 units when measured with a 60 degree meter.

E. **Drywall Finishing Levels**: Except where otherwise specified, a Drywall Finishing Level 5 is required on gypsum board substrates scheduled to receive an eggshell or higher sheen. Drywall Finishing Level 4 is acceptable with the use of flat and low-sheen paints, except where critical lighting conditions are determined to be an issue by the Architect.

F. **Surfaces to be Painted**: Except where natural finish of material is specifically noted as a surface not to be painted, paint all exposed surfaces whether or not colors are designated in "schedules". Where items or surfaces are not specifically mentioned, paint the same as similar adjacent materials or areas. If color or finish is not designated, Architect will select these from manufacturer's full range of colors and finishes. Multiple colors will be selected by the Architect for any type of paint system. If colors are not indicated on the drawings, provide for a minimum of 20 percent of the walls to be an accent color.
1. Surface preparation, priming and coats of paint specified are in addition to shop-priming and surface treatment specified under other sections of work.
2. Walls behind scheduled coverings shall receive prime coat.
3. If it can be seen, *paint it*.

G. **Following categories of work are not included** as part of field-applied finish work:
1. **Pre-Finished Items**: Unless otherwise indicated, do not include painting when factory-finishing or installer-finishing is specified for such items as (but not limited to) metal toilet enclosures, pre-finished partition systems, architectural woodwork and casework, elevator entrance doors and frames, elevator equipment, and finished mechanical and electrical equipment, including light fixtures, switchgear and distribution cabinets.
2. **Concealed Surfaces**: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, foundation spaces, furred areas, utility tunnels, pipe spaces and duct shafts.
3. **Finished Metal Surfaces**: Unless otherwise indicated, metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting.
4. **Operating Parts**: Unless otherwise indicated, moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts will not require finish painting.
5. **Labels**: Do not paint over any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

1.3 SUBMITTALS

A. **Product Data**: Submit manufacturer's technical information including Paint label analysis and application instructions for each material proposed for use.

B. **Sustainability**: For paints and coatings, printed statement of VOC content demonstrating conformance to Utah Air Quality Regulations (R307-361).

C. **Samples**: Prior to beginning work, review **Finish Schedule** for colors to be painted. Use representative colors when preparing samples for review. Submit samples for Architect's review of color and texture only. Provide a listing of material and application for each coat of each finish sample.

1. On 12 inch x 12 inch hardboard, provide two samples of each color and material, with texture to simulate actual conditions. Resubmit samples as requested by Architect until acceptable sheen, color, and texture is achieved.
2. On actual wood surfaces, provide two 4 inch x 8 inch samples of natural and stained wood finish. Label and identify each as to location and application.
3. On actual wall surfaces and other exterior and interior building components, duplicate painted finishes of prepared samples. Refer to “Mockups” below.

1.4 QUALITY ASSURANCE

A. **Single Source Responsibility**: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.

B. **Coordination of Work**: Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information or characteristics of finish materials provided for use, to ensure compatible prime coats are used.

C. **Mockups**: Apply full-coat mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. Simulate finished lighting conditions for review of in-place work.

1. Architect will select one surface, except as noted below, to represent surfaces and conditions for application of each paint system.
   a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
   b. Other Items: Architect will designate items or areas required.
   c. Masonry to Receive Clear Coat: Provide free-standing samples of honed masonry, 48 inches x 48 inches for initial review of clear coat. Provide larger sample areas based on tentative selection of clear coat by Architect.
2. Final approval of color selections will be based on mockups.
   a. If preliminary color/sheen selections are not approved, apply additional mockups of additional colors/sheens selected by Architect at no added cost to Owner.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY AND STORAGE

A. **Deliver materials** to job site in original, new and unopened packages and containers bearing manufacturer's name and label, and following information:

1. Name or title of material.
2. Federal Specification number, if applicable..
3. Manufacturer's batch number and date of manufacture.
4. Manufacturer's name.
5. Contents by volume, for major pigment and vehicle constituents.
6. Thinning instructions.
7. Application instructions.

8. Color name and number.

B. **Store materials** not in actual use in tightly covered containers. Maintain containers used in storage of paint in a clean condition, free of foreign materials and residue.
   1. Protect from freezing where necessary. Keep storage area neat and orderly. Remove oily rags and waste daily. Take all precautions to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of paints.

1.6 PROJECT CONDITIONS

A. **Apply water-based paints** only when temperature of surfaces to be painted and surrounding air temperatures are between 50 deg. F and 90 deg. F, unless otherwise permitted by paint manufacturer's printed instructions.

B. **Apply solvent-thinned paints** only when temperature of surfaces to be painted and surrounding air temperatures are between 45 degrees F and 95 degrees F, unless otherwise permitted by paint manufacturer's printed instructions.

C. **Do not paint in snow, rain, fog or mist,** or when relative humidity exceeds 85 percent, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions.
   1. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.

D. **Determine moisture content of surfaces** to be painted by performing appropriate tests using a commercially available moisture meter. Apply paint only when surfaces are within limits specified by the paint manufacturer’s printed instructions.

1.7 MAINTENANCE MATERIALS

A. **Furnish extra materials** that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Paint: 5 percent, but not less than 1 gallon (3.8 L) of each material and color applied.
   2. Coating Maintenance Manual: upon conclusion of the project, the Contractor or paint manufacture/supplier shall furnish a coating maintenance manual, such as Sherwin-Williams “Custodian Project Color and Product Information” report or equal. Manual shall include an Area Summary with finish schedule, Area Detail designating where each product/color/finish was used, product data pages, Material Safety Data Sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. **Basis of Design Manufacturer**: Contract Documents are based on products specified in Part 3 Schedules to establish a standard of quality. Other acceptable manufacturers offering products with equivalent characteristics may be considered, provided deviations are minor and design concept as expressed in the Contract Documents is not changed, as judged by the Architect.
   1. Manufacturer: **Sherwin-Williams** Company.

B. **Acceptable Manufacturers**: Subject to compliance with requirements of Contract Documents, provide products by one of the following manufacturers.
   1. PPG Industries, Pittsburgh Paints.
   2. The Sherwin-Williams Company (S-W).
   3. Benjamin Moore & Co.
   4. Comex (Kwal) Group Paint.

2.2 MATERIALS

A. **Low-Emitting Materials -** VOC Content (Utah Administrative Code R307-361): Products shall comply with VOC limits of authorities having jurisdiction and, for interior and exterior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24)].
   1. Flat Paints and Coatings: 50 g/L.
   2. Nonflat Paints and Coatings: 100 g/L.
   3. Dry-Fog Coatings: 150 g/L.
   4. Primers, Sealers, and Undercoaters: 100 g/L.
   5. Industrial maintenance Coatings Applied to Ferrous Metals: 250 g/L.
   6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
   7. Pretreatment Wash Primers: 420 g/L.
   8. Floor Coatings Foot Traffic: 100 g/L.
   9. Floor Coatings High Performance: 250 g/L.
   10. Shellacs, Clear: 730 g/L.
   11. Shellacs, Pigmented: 550 g/L.
   12. Wood Coatings: 275 g/L

B. **Material Quality**: Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable.

C. **Proprietary names** used to designate color or materials are not intended to imply that products of named manufacturers are required to exclusion of equivalent products of other manufacturers.

D. **Federal Specifications** establish minimum acceptable quality for paint materials. Provide written certification from paint manufacturer that materials provided meet or exceed these minimums.

E. **Manufacturer's products** which comply with coating qualitative requirements of applicable Federal Specifications, yet differ in quantitative requirements, may be considered for use when acceptable to Architect. Furnish material data and manufacturer's certificate of performance to Architect for any proposed substitutions.

F. **Color Pigments**: Pure, non-fading, applicable types to suit substrates and service indicated.

G. **Lead content in pigment**, if any, is limited to contain not more than 0.009 percent lead, as lead metal based on the total non-volatile (dry-film) of paint by weight.
   1. This limitation is extended to interior surfaces and those exterior surfaces, such as stairs, decks, porches, railings, windows, and doors which are readily accessible to children under seven years of age.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Applicator must examine areas** and conditions under which painting work is to be applied and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Applicator.
   1. Comply with PDCA Standard P4 “Responsibility for Inspection and Acceptance of Surfaces prior to Painting and Decorating

B. **Starting of painting work** will be construed as Applicator's acceptance of surfaces and conditions within any particular area.

C. **Do not paint over dirt**, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

3.2 PREPARATION

A. **General**: Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition.

B. **Barrier Coats**: Provide barrier coats over incompatible primers or remove and re-prime as required. Notify Architect in writing of any anticipated problems in using the specified coating systems with substrates primed by others.

C. **Accessories Removal**: Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items.

D. **Surface Preparation**: Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly-painted surfaces.

E. **Cementitious Materials**: Prepare cementitious surfaces to be painted by removing efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze.
   1. Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application of paint. Do not paint over surfaces where moisture content exceeds that permitted in manufacturer's printed directions.
   2. Concrete Floors:
      a. Floors must be structurally sound and fully cured a minimum of 28 days. Test floor for vapor drive in accordance with ASTM D 4263, ASTM F 2170 or ASTM F 2420. If vapor drive exceeds the levels recommended by the manufacturer of the flooring system, a moisture mitigation system, as approved by Architect, may be applied to reduce the permeance of moisture vapor to acceptable levels.
      b. Repair concrete as necessary.
      c. Use a commercial degreaser to clean floors of oil, grease, and other bond

inhibiting materials.

d. Remove curing and parting compounds and other surface hardeners and floor coatings in accordance with the manufacturer's instructions.

e. Mechanical surface profiling is the recommended method of surface preparation for both new and existing floors. Mechanically profile the floor to CSP 3 (approximately medium grit sandpaper) as described by the International Concrete Repair Institute (Guideline #310.2). Do not use acid etching for surface preparation. Do not use any method that will fracture the concrete.

f. Apply a 25 square foot (2.32 square meter) test in an inconspicuous area that meets Owner's expectation for appearance, slip resistance and performance.

F. **Ferrous Metals**: Clean ferrous surfaces, which are not galvanized or shop-coated, of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning.

1. Caulk fabrication joints in hollow metal door frames which paint application cannot bridge.
2. Follow manufacturer's surface preparation recommendations for ferrous metal substrates, ranging from one of the following procedures:
   a. SSPC-SP 1 - Solvent Cleaning (Nov-04)
   b. SSPC-SP 2 - Hand Tool Cleaning (Nov-04)
   c. SSPC-SP 3 - Power Tool Cleaning (Nov-04)
   d. SSPC-SP 5/NACE No. 1 - White Metal Blast Cleaning (Jan-07)
   e. SSPC-SP 6/NACE No. 3 - Commercial Blast Cleaning (Jan-07)
   f. SSPC-SP 7/NACE No. 4 - Brush-Off Blast Cleaning (Jan-07)
   g. SSPC-SP 8 - Pickling (Nov-04)
   h. SSPC-SP 10/NACE No. 2 - Near-White Metal Blast Cleaning (Jan-07)
   i. SSPC-SP 11 - Power Tool Cleaning to Bare Metal (July-12)
   j. SSPC-SP 14/NACE No. 8 - Industrial Blast Cleaning (Jan-07)
   k. SSPC-SP 15 - Commercial Grade Power-Tool Cleaning (July-12)
   l. SSPC-SP 16 - Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals (Apr-10

G. **Touch-up**: Touch-up shop-applied prime coats wherever damaged or bare, where required by other sections of these specifications. Clean and touch-up with same type shop primer.

H. **Galvanized Surfaces**: Clean free of oil and surface contaminants with non-petroleum based solvent. Comply with best practices specified in ASTM D6386 - 10 "Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting."

I. **Materials Preparation**:

1. Mix and prepare painting materials in accordance with manufacturer's directions.
2. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
3. Stir materials before application to produce a mixture of uniform density, and stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

3.3 APPLICATION

A. **General**: Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes, are indicated in "schedules" of the

contract documents.

2. Provide finish coats which are compatible with prime paints used.
3. Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Give special attention to insure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
4. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently-fixed equipment or furniture with prime coat only before final installation of equipment.
5. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.
6. Paint back sides of access panels, and removable or hinged covers to match exposed surfaces.
7. Finish doors on tops, bottoms and side edges same as faces, unless otherwise indicated.
8. Sand lightly between each succeeding enamel or varnish coat.
9. Omit first coa**t** (exterior faces) of surfaces which have been shop-primed and touch-up painted, unless otherwise indicated.

B. **Scheduling Painting**: Apply first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. Re-coat Time: Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firms, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.
2. Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as indicated or, if not indicated, as recommended by coating manufacturer.

C. **Mechanical and Electrical Work**: Painting of mechanical and electrical work is limited to those items exposed to mechanical equipment rooms and in occupied spaces.

1. **Mechanical items** to be painted include, but are not limited to, the following:
   a. Piping, pipe hangers, and supports.
   b. Roof mounted mechanical units.
   c. Ductwork, where exposed in occupied spaces.
   d. Motor, mechanical equipment, and supports.
   e. Accessory items.
2. **Electrical items** to be painted include, but are not limited to, the following:
   a. Conduit and fittings.

D. **Prime Coats**: Apply prime coat of material which is required to be painted or finished, and which has not been prime coated by others.

1. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

E. **Pigmented (Opaque) Finishes**: Completely cover to provide an opaque, smooth 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.

F. **Completed Work**: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

3.4 FIELD QUALITY CONTROL

A. **Owner will engage services of an independent testing laboratory** to sample paint being used. Samples of materials delivered to project site will be taken, identified and sealed, and certified in presence of Contractor.

1. Testing laboratory will perform appropriate tests for any or all of following characteristics: Abrasion resistance, apparent reflectivity, flexibility, washability, absorption, accelerated weathering, dry opacity, accelerated yellowness, recoating, skinning, color retention, alkali resistance and quantitative materials analysis.

B. **If test results show** that material being used does not comply with specified requirements, Contractor may be directed to stop painting work, and remove non-complying paint; pay for testing; repaint surfaces coated with rejected paint; remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are non-compatible.

3.5 CLEAN-UP AND PROTECTION

A. **Clean-Up**: During progress of work, remove from site discarded paint materials, rubbish, cans and rags at end of each work day.

1. Upon completion of painting work, clean window glass and other paint spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using car not to scratch or otherwise damage finished surfaces.

B. **Protection**: Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

1. Provide "Wet Paint" signs as required to protect newly-painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.
2. At completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

3.6 EXTERIOR PAINT SCHEDULE

A. **General**: Provide the following paint systems for the various substrates as indicated below or equivalent system from approved manufacturers listed above.

B. **METAL** (Aluminum)

Sherwin-Williams - Latex (100% Acrylic) Systems

1st Coat: S-W Pro Industrial Zero VOC Acrylic Gloss, B66-600 Series

2nd Coat: S-W Pro Industrial Zero VOC Acrylic Gloss, B66-600 Series

Finish: Gloss

Thickness (Mils per coat): 6 - 12 wet; 2.5 - 4 dry.

C. **METAL** (Galvanized)

Sherwin-Williams - Latex (100% Acrylic) Systems

1st Coat: S-W Pro Industrial Pro-Cry Universal Primer B66-310 Series
Finish: Low sheen.
Thickness: (Mils per coat) 5 - 10 wet; 2 - 4 dry.
VOC: Less than 100 g/L

2nd Coat: S-W Pro Industrial Zero VOC Acrylic Gloss, B66-600 Series

3rd Coat: S-W Pro Industrial Zero VOC Acrylic Gloss, B66-600 Series
Finish: Gloss
Thickness: (Mils per coat) 6 - 12 wet; 2.5 - 4 dry.

D. **METAL** (Misc. Iron, Ornamental Iron, Cat Walks, Fire Escapes, Hydrants, Handrails, Ladders, Fences, etc.)

Sherwin-Williams - Latex (100% Acrylic) Systems

1st Coat: S-W Pro Industrial Pro-Cry Universal Primer B66-310 Series
Finish: Low sheen.
Thickness: (Mils per coat) 5 - 10 wet; 2 - 4 dry.
VOC: Less than 100 g/L (LEED VOC limits do not apply on exterior)

2nd Coat: S-W Pro Industrial Zero VOC Acrylic Gloss, B66-600 Series

3rd Coat: S-W Pro Industrial Zero VOC Acrylic Gloss, B66-600 Series
Finish: Gloss
Thickness: (Mils per coat) 6 - 12 wet; 2.5 - 4 dry.

E. **CONCRETE (Exterior Painted)**

Surface Preparation: Allow new cast-in-place concrete to cure minimum of 28 days at 75 degrees F. Verify concrete dryness and prepare concrete surfaces in accordance with SSPC-SP13 and ICRI Technical Guidelines. Abrasive blast or high pressure water blast concrete surfaces to remove laitance, curing compounds, hardeners, sealers and other contaminants and to provide and ICRI-CSP 2-3 surface profile.

Tnemec - Acrylic

1st Coat: Tnemec Enviro-Crete Series 156.
Finish: Matte.
Thickness (Mils per coat): 6 - 8 dry.

2nd Coat: Tnemec Enduratone Series 1028
Finish: Gloss
Thickness (Mils per coat): 2 - 3 dry.

3rd Coat: Tnemec Enduratone Series 1028
Finish: Gloss
Thickness (Mils per coat): 2 - 3 dry.

3.7 INTERIOR PAINT SCHEDULE

A. **General**: Provide the following paint systems for the various substrates as indicated below or equivalent system from approved manufacturers listed above.

B. **MASONRY PAINTED** (Interior Concrete Masonry Units)

Sherwin-Williams - Vinyl Acrylic Systems
- **1st Coat:** S-W ProMar Interior/Exterior Block Filler B25W25
  - Finish: Flat
  - Thickness: (Mils per coat) 16 wet - 8 dry.
- 2nd Coat: S-W ProMar 200 Zero VOC Semi-Gloss, B31-2600 Series
- 3rd Coat: S-W ProMar 200 Zero VOC Semi-Gloss, B31-2600 Series
  - Finish: Semi-Gloss
  - Sheen (at 60 degrees): 25-35 units.
  - Thickness (Mils per coat): 4 wet - 1.6 dry.

Sherwin-Williams - Epoxy System - 100% Acrylic base coat (Water Base)
- 1st Coat: S-W Heavy Duty Block Filler, B42W46
  - Finish: Flat
  - Thickness: (Mils per coat) 18 - 34 wet, 10 - 18 dry.
  - VOC: Less than 50 g/L
- 2nd Coat: S-W Pro Industrial Zero VOC Water-Based Epoxy Gloss, B73-300 Series.
- 3rd Coat: S-W Pro Industrial Zero VOC Water-Based Epoxy Gloss, B73-300 Series.
  - Finish: Gloss
  - Sheen (at 60 degrees): 90+ units.
  - Thickness (Mils per coat): 5 - 10 wet; 2 - 4 dry.
  - VOC: 0 g/L

C. **METAL** - (Interior Galvanized)

Sherwin-Williams - Latex (100% Acrylic) Systems
- 1st Coat: S-W Pro Industrial Pro-Cry Universal Primer B66-310 Series
  - Finish: Low sheen.
  - Thickness: (Mils per coat) 5 - 10 wet; 2 - 4 dry.
  - VOC: Less than 100 g/L
- 2nd Coat: S-W Pro Industrial Zero VOC Acrylic Semi-Gloss, B66-650 Series
- 3rd Coat: S-W Pro Industrial Zero VOC Acrylic Semi-Gloss, B66-650 Series
  - Finish: Semi-Gloss
  - Thickness: (Mils per coat) 6 - 12 wet; 2.5 - 4 dry.

D. **METAL** - (Interior Structural Steel **-** Columns, Joists, Trusses, Beams - Misc. & Ornamental Iron, Doors, Door Frames, Non-Galvanized Metal)

Sherwin-Williams - Latex (100% Acrylic) Systems

1st Coat: S-W Pro Industrial Pro-Cry Universal Primer B66-310 Series
Finish: Low sheen.
Thickness: (Mils per coat) 5 - 10 wet; 2 - 4 dry.
VOC: Less than 100 g/L

2nd Coat: S-W Pro Industrial Zero VOC Acrylic Gloss, B66-600 Series

3rd Coat: S-W Pro Industrial Zero VOC Acrylic Gloss, B66-600 Series
Finish: Gloss
Thickness: (Mils per coat) 6 - 12 wet; 2.5 - 4 dry.

E. **METAL** - **Clear Finish Interior Miscellaneous Metal** (such as guardrails etc.)
Aliphatic urethane or Polyurethane Clear Coat Sealer (used as a rust-preventative coating):
Provide three coats of sealer (the first coat must be shop applied, the second and third coat may be shop applied or field applied at the Contractor's option.)
Available manufacturers include but are not limited to the following:
Corotech (Benjamin Moore) V500 Aliphatic Acrylic Urethane Gloss.
Finish: Gloss
Thickness (Mils per coat): 3.5 - 5.0 wet; 2.5 - 3.6 dry.
VOC: 228 g/L

G. **METAL - Overhead**

Surface Preparation:

1. Steel: Minimum surface preparation is Hand Tool Clean per SSPC-SP2. Remove all oil and grease from surface by Solvent Cleaning per SSPC-SP1. For better performance, use Commercial Blast Cleaning per SSPC-SP6/NACE 3, blast clean all surfaces using a sharp, angular abrasive for optimum surface profile (2 mils). Prime any bare steel within 8 hours or before flash rusting occurs. Primer required.

Sherwin-Williams: Dryfall system.

1st Coat (Steel): S-W Pro Industrial Pro-Cry Universal Primer B66-310 Series
Finish: Low sheen.
Thickness: (Mils per coat) 5 - 10 wet; 2 - 4 dry.
VOC: Less than 100 g/L

2nd Coat: S-W Pro Industrial Waterborne Acrylic Dryfall B42 Series

3rd Coat: S-W Pro Industrial Waterborne Acrylic Dryfall B42 Series
Finish: As selected by Architect from mockup
Thickness: (Mils per coat) 6 - 9 wet; 2 - 3 dry.
VOC: <50 g/L

END OF SECTION

DIVISION 10 - SPECIALTIES

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SECTION 10 1400

SIGNS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This **Section includes** the following types of signs:
   1. Panel signs.
      a. Handicap accessibility signs.
      b. Identification signs.
      c. Maximum occupancy load signs
   2. Vinyl Graphics - Pressure Sensitive.
   3. Exterior Signs.
      a. Safety and rules signage.
   4. Building Identification and Plaques.
      a. Dimensional letters and numbers.

1.3 SUBMITTALS

A. **Product Data**: Provide product data for each type of sign specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.

B. **Shop drawings**: Provide shop drawings showing fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, layout, reinforcement, accessories, and installation details.
   1. Provide message list for each sign required, including large-scale details of wording and lettering layout.

C. **Samples**: Provide the following samples of each sign component for initial selection of color, pattern and surface texture as required and for verification of compliance with requirements indicated.
   1. Samples for selection of color, pattern, and texture:
      a. Cast Acrylic Sheet and Plastic Laminate: Manufacturer's color charts consisting of actual sections of material including the full range of colors available for each material required.

1.4 QUALITY ASSURANCE

A. **Sign Fabricator Qualifications**: Firm experienced in producing signs similar to those indicated for this Project, with a record of successful in-service performance, and sufficient production capacity to produce sign units required without causing delay in the Work.

B. **Single-Source Responsibility**: For each separate sign type required, obtain signs from one source of a single manufacturer.

C. **Handicapped Accessibility**: Provide signs which are in conformance with the requirements of ANSI A117.1-1998 and the Americans with Disabilities Act of 1990 (ADA).

D. **Design Concept**: The Drawings indicate sizes, profiles, and dimensional requirements of signs and are based on the specific types and models indicated. Sign units by other manufacturers may be considered provided deviations in dimensions and profiles do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.

1.5 DELIVERY AND HANDLING

A. **Delivery**: Provide protective covering or crating as recommended by the manufacturer to protect sign components and surfaces against damage during transportation and delivery.

B. **Handling**: Handle signs carefully to prevent breakage, surface abrasion, denting, soiling, and other defects. Comply with the manufacturer's written handling instructions for unloading components subject to damage.
1. Inspect sign components for damage on delivery.
2. Do not install damaged sign components.
3. Repair minor damage to signs, provided the finished repair is equal in all respects to the original work and is approved by Architect; otherwise, remove and replace damaged sign components.

1.6 PROJECT CONDITIONS

A. **Field Measurements**: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

1.7 WARRANTY

A. **General Warranty**: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. **Warranty Period**: 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. **Available Manufacturers**: Subject to compliance with requirements of Contract Documents, manufacturers offering products that may be incorporated in the Work include but are not limited to the following:

1. **Manufacturers of Panel Signs**:
   a. A. R. K. Ramos
   b. Allotech, Inc.
   c. Andco Industries
   d. ASI Sign Systems, Inc.
   e. Best Manufacturing Company.
   f. Gemini
   g. Interpretive Graphics
   h. Kroy Architectural Signing
   i. Thomas & Sons LLC.
   j. Vomar Products, Inc.

2.2 MATERIALS

A. **Raised Graphics and Tactile Signs**: Provide chemically welded, adhesive mounted or glued and mechanically engraved graphics, text and Braille panels that comply with requirements indicated for materials, thickness, colors, designs, shapes sized and details of construction.

1. Panel signs shall comply with applicable provisions of the ADA Accessibility Guidelines (ADAAG) and ICC / ANSI A177.1/98 including 0.0312 inch raised tactile characters, 4 inch pictograms, 0.625 inch upper case text, sans serif type styles and Grade II Braille shall be positioned directly beneath the text.

B. **Cast Acrylic Sheet**: Provide cast (not extruded or continuous cast) methyl methacrylate monomer plastic sheet, in sizes and thicknesses indicated, with a minimum flexural strength of 16,000 psi when tested according to ASTM D 790, with a minimum allowable continuous service temperature of 176 degrees F, and of the following general types:

1. Opaque Sheet: Where sheet material is indicated as "opaque," provide colored opaque acrylic sheet in colors and finishes as selected from the manufacturer's standards.

2.3 PANEL SIGNS

A. **General**: Provide panel signs that comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.

1. Produce smooth panel sign surfaces constructed to remain flat under installed conditions within tolerance of plus or minus 1/16 inch1.5 mm measured diagonally.

B. **Basis-of-Design Product**: **ASI Sign Systems**, Inc.; **ADA-Ready**, **In Touch System** or a comparable product of one of the other manufacturers listed.

C. **Materials**:

1. **Acrylic**: Non-glare acrylic sheet, continuously processed with a matte finish that complies with ANS Z97.1-1984 Safety Glazing requirements.
2. **Vinyl**: 3M Scotchcal film Series 220/Series 225 precision plotted in sizes and colors indicated.

D. **Unframed Panel Signs**: Fabricate signs with edges mechanically and smoothly finished to comply with the following requirements:
   1. Edge Condition: Square cut.
   2. Corner Condition: Square.
   3. Depth: 0.25 inch thickness.
   4. Panel Appearance: As selected by Architect.
   5. Color: As selected by Architect from manufacturers full range of colors.
   6. Surface Texture: As selected by Architect.
   7. Letter Style: Arial.
   8. Letter Height: As scheduled.

E. **Graphic Content and Style**: Provide sign copy that complies with requirements indicated in the **Sign Schedule** for size, style, spacing, content, mounting height and location, material, finishes, and colors of signage.
   1. Provide signage indicating handicap entry at each set of ADA accessible entry doors into facility.
   2. Provide maximum occupancy load signs in assembly rooms as required by code.
   3. Provide room identification signage as noted on Drawings.

F. **Tactile and Braille Copy**: Manufacturer's standard process for producing copy complying with ADA Accessibility Guidelines and ICC/ANSI A117.1. Text shall be accompanied by Grade 2 braille. Produce precisely formed characters with square cut edges free from burrs and cut marks.
   1. Raised-Copy Thickness: Not less than 1/32 inch0.8 mm.

G. **Colored Coatings**: For copy and background colors, provide Pantone Matching System (PMS) colored coatings, including inks and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are nonfading for application intended.

H. **Metal Finishes**: Comply with NAAMM "Metal Finishes Manual" for finish designations and applications recommendations.

I. **Aluminum Finishes**: Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
   1. **Baked-Enamel Finish**: AA-M4xC12C42R1x (Mechanical Finish: Manufacturer's standard, other nondirectional textured; Chemical Finish: Chemical conversion coating, acid chromate-fluoride-phosphate pretreatment; Organic Coating: as specified below). Apply baked enamel in compliance with paint manufacturer's specifications for cleaning, conversion coating, and painting.
      a. Organic Coating: Thermosetting-modified acrylic enamel primer/topcoat system complying with AAMA 603.8 except with a minimum dry film thickness of 1.5 mils, medium gloss.
         1) Color: As selected by the Architect from the manufacturer's standard colors.

2.4 PRESSURE SENSITIVE VINYL GRAPHICS

A. **Provide graphics** on **pressure sensitive vinyl film** where indicated on Drawings. Vinyl to be equal to:
   1. 3M 'Scotchcal' changeable translucent graphic film IJ63-20.
   2. Graphics are to be provided by the Architect in digital format and are to be transferred to the vinyl as a digital print.

2.5 PAINTED/STENCILED SIGNS

A. **At fire walls, fire barriers, fire partitions, smoke barriers, smoke partitions** or any other wall required to have protected openings or penetrations, provide permanent painted signage.

B. **Locate signage in accessible, but concealed, spaces**, such as above finished lay-in ceilings, attic spaces, etc. Signage shall be placed so as to be visible to any tradesman performing work at the wall. Signs shall be repeated at intervals not less than 30 feet, measured horizontally along wall.

C. **Lettering**: 2 inch high, minimum; black or other contrasting color.

D. **Wording**: "FIRE OR SMOKE BARRIER. PROTECT ALL OPENINGS".

2.6 EXTERIOR DIRECTIONAL AND PARKING SIGNS

A. **Panel Signs**: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
   1. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally.

B. **Sign Panels**: Provide smooth, even, level sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch (1.5 mm) measured diagonally from corner to corner.
   1. Unframed Single-Sheet Panels: Provide unframed single-sheet sign panels with edges mechanically and smoothly finished to conform to the following:
      a. Panel Material: 0.08-inch- (2-mm-) thick aluminum sheet.
         1) Panel Finish: Manufacturer's standard semigloss finish with UV inhibitors.
      b. Edge Condition: Square cut.
      c. Corner Condition: 1/2 inch radius corners.

D. **Graphic Content and Style**: Provide sign copy that complies with the requirements indicated for size, style, spacing, content, position, material, finishes, and colors of letters, numbers, and other graphic devices.
   1. Copy on Panels: Apply computer-generated adhesive graphics to panel. Graphics to be engineer grade vinyl. Apply as per manufacturer’s recommendations
      a. Provide signage indicating pool safety rules and other information as indicated on Drawings.

E. **Fabrication**:
   1. **General**: Provide manufacturer's standard single-panel-type signs. Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
      a. Allow for thermal movement resulting from a maximum ambient temperature change (range) of 100 degrees F (38 degrees C). Design, fabricate, and install post and panel sign assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners.
         1) Base design on actual surface temperatures of metals due to both solar heat gain and nighttime-sky heat loss.

b. Welded Connections: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded surfaces of welding flux and dress on exposed and contact surfaces.
c. Mill joints to a tight, hairline fit. Form joints exposed to the weather to exclude water penetration.
d. Preassemble signs in the shop to the greatest extent possible to minimize field assembly. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in a location not exposed to view after final assembly.
e. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

2. **Panels**: Form panels to required size and shape. Comply with requirements indicated for design, dimensions, finish, color, and details of construction.
a. Coordinate dimensions and attachment methods to produce message panels with closely fitting joints. Align edges and surfaces with one another in the relationship indicated.
b. Increase metal thickness or reinforce with concealed stiffeners or backing materials as required to produce surfaces without distortion, buckles, warp, or other surface deformations.
c. Continuously weld joints and seams, unless other methods are indicated; grind, fill, and dress welds to produce smooth, flush, exposed surfaces with welds invisible after final finishing.

2.7 DIMENSIONAL LETTERS AND NUMBERS

A. **Cast Letters and Numbers**: Form individual letters and numbers by casting. Produce characters with smooth, flat faces, sharp corners, and precisely formed lines and profiles, free from pits, scale, sand holes, or other defects. Cast lugs into the back of characters and tap to receive threaded mounting studs. Comply with requirements indicated for finish, style, and size.
1. Metal: Aluminum.
2. Building Information: Provide letters of size and style as indicated on the Drawings. Attach to exterior of building as directed by Architect.

PART 3 - EXECUTION

3.1 INSTALLATION

A. **General**: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.
1. Install signs level, plumb, and at the height indicated, with sign surfaces free from

B. **Wall-Mounted Panel Signs**: Attach panel signs to wall surfaces using the methods indicated below:
1. **Interior Wall Signs**: Install signs as indicated on the drawings or if not indicated then as follows: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches (75 mm) of sign without encountering protruding objects or standing within swing of door.
a. Mounting Method – smooth surfaces: Use two-face tape. Mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.

b. Mounting Method – rough or vinyl surfaces: Use silicone-adhesive mounting. Attach signs to irregular, porous, or vinyl-covered surfaces.
c. Signs Mounted on Glass: Use two-face tape. Provide matching opaque plate (plate to be of the same color and texture as the sign.) on opposite side of glass to conceal mounting materials.

C. **Vinyl Graphics - Pressure Sensitive:** Apply to substrate as per manufacturer's written recommendations.

D. **Dimensional Letters and Numbers**: Mount letters and numbers using standard fastening methods recommended by the manufacturer for letter form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish letter spacing and to locate holes for fasteners. Letters are to be offset from wall surface.

3.2 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

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SECTION 10 2800

TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. **Section includes toilet** and **bath accessories** including but not limited to the following:
1. Grab bars.
2. Toilet tissue dispensers.
3. Paper towel dispensers.
4. Soap dispensers.
5. Sanitary napkin disposal units.
6. Mirrors.
7. Warm-air dryers.
8. Underlavatory guards.
9. Mop and broom holder.
10. Diaper changing stations.
11. Shower accessories including rod, curtain, and barrier-free seat.
12. Hooks.

B. **Related Sections**:
1. Section 06 1053 "**Miscellaneous Rough Carpentry**" for concealed blocking supporting wall-hung accessories.

1.3 SUBMITTALS

A. **Product Data**: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.

B. **Samples**: For each accessory item to verify design, operation, and finish requirements.
1. Approved full-size Samples will be returned and may be used in the Work.

C. **Setting Drawings**: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.

D. **Product Schedule**: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated in the Toilet and Bath Accessory Schedule and room designations indicated on Drawings in product schedule.

E. **Maintenance Data**: For accessories to include in maintenance manuals specified in Division 1. Provide lists of replacement parts and service recommendations.

1.4 QUALITY ASSURANCE

A. **Source Limitations**: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Architect.

B. **Product Options**: Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specific products indicated in the Toilet and Bath Accessory Schedule.
   1. Products of other manufacturers listed in Part 2 with equal characteristics, as judged solely by Architect, may be provided.
   2. Do not modify aesthetic effects, as judged solely by Architect, except with Architect's approval. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.5 COORDINATION

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

B. **Deliver inserts** and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

A. **General Warranty**: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. **Manufacturer's Mirror Warranty**: Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.
   1. **Minimum Warranty Period**: **15 years** from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. **Available Manufacturers**: Subject to compliance with requirements of Contract Documents, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. **Toilet and Bath Accessories**:
      a. AJW, a Fifty Door Partners company.
      b. ASI (American Specialties, Inc.)
      c. Bobrick Washroom Equipment, Inc.
      d. Bradley Corporation.
      e. General Accessory Manufacturing Co. (GAMCO), a division of Bobrick.

2. **Hand Dryers**:
   a. Dyson.
   b. Mitsubishi.
   c. Saniflow.
   d. Toto.
   e. World.
3. **Underlavatory Guards**:
   a. Brocar Products, Inc.
   b. Truebro, Inc.

2.2 MATERIALS

A. **Stainless Steel**: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. **Brass**: ASTM B 19, leaded and unleaded flat products; ASTM B 16, rods, shapes, forgings, and flat products with finished edges; ASTM B 30, castings.

C. **Sheet Steel**: ASTM A 366/A 366M, cold rolled, commercial quality, 0.0359-inch minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.

D. **Galvanized Steel Sheet**: ASTM A 653/A 653M, G60.

E. **Chromium Plating**: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.

F. **Baked-Enamel Finish**: Factory-applied, gloss-white, baked-acrylic-enamel coating.

G. **Mirror Glass**: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.

H. **Galvanized Steel Mounting Devices**: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

I. **Fasteners**: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

2.3 FABRICATION

A. **General**: Names or labels are not permitted on exposed faces of accessories. On interior surface not exposed to view or on back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.

B. **Surface-Mounted Toilet Accessories**: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.

C. **Recessed Toilet Accessories**: Unless otherwise indicated, fabricate units of all-welded construction, without mitered corners. Hang doors and access panels with full-length, stainless-steel hinge. Provide anchorage that is fully concealed when unit is closed.

D. **Framed Glass-Mirror Units**: Fabricate frames for glass-mirror units to accommodate glass edge protection material. Provide mirror backing and support system that permits rigid, tamper-resistant glass installation and prevents moisture accumulation.
   1. Provide galvanized steel backing sheet, not less than 0.034 inch and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.

E. **Mirror-Unit Hangers**: Provide mirror-unit mounting system that permits rigid, tamper- and theft-resistant installation, as follows:
   1. Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

F. **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.

B. **Secure mirrors** to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.

C. **Install grab bars** to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. **Adjust accessories** for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.

B. **Remove temporary labels** and protective coatings.

C. **Clean and polish** exposed surfaces according to manufacturer's written recommendations.

3.3 TOILET AND BATH ACCESSORY SCHEDULE

A. **Toilet Tissue Dispenser**:
   1. Basis of Design: Bobrick, B-288.
   2. Type: Roll-in-reserve dispenser with hinged front secured with tumbler lockset
   3. Mounting: Surface mounted with concealed anchorage.
   4. Material: Stainless steel.
   5. Operation: Noncontrolled delivery with manufacturer's standard theft-resistant spindle.
      a. Capacity: Designed for 5-inch- diameter-core tissue rolls.

B. **Towel Dispenser:**
1. Basis of Design: Bobrick, B- 262
2. Surface Mounted Type. Type-304 satin finish stainless steel with all-welded construction; dispensing 400 C-fold or 800 multifold paper towels.

C. **Surface Mounted - Wall Soap Dispenser**:
1. Basis of Design: Bobrick B2112.
2. Vertical tank in satin finish stainless steel. Corrosion resistant valve capable of dispensing liquid and lotion soaps and synthetic detergents. Capacity: 40 fl oz.

D. **Grab Bars**:
1. Basis of Design: Bobrick, B-6806 Series. Length as indicated on Drawings.
2. Stainless-Steel Nominal Thickness: Minimum 0.05 inch.
3. Mounting: Concealed with manufacturer's standard flanges and anchors.
4. Finish: Satin.
5. Outside Diameter: 1-1/2 inches for heavy-duty applications.

E. **Sanitary Napkin Disposal Unit**:
1. Basis of Design: Bobrick, B-254.
2. Surface-Mounted Type: Type 304 stainless steel; seamless exposed walls; self-closing panel with hemmed bottom edge and secured to door with spring-loaded, full-length stainless steel piano hinge; locking (keyed to match other accessories) door with stainless-steel, continuous hinge; and removable, leak-proof, 1.2 gallon polyethylene receptacle.

F. **Mirror Unit:**
1. Basis of Design: Bobrick, B-290 Series.
2. Frame: 18-8 S, type 304, heavy-gauge stainless steel, 3/4 inch x 3/4 inch (19 x 19mm) angle with vertical-grain satin finish. One piece, roll-formed construction forms continuous integral stiffener on all sides. Bevel design on front of angle holds frame tightly against mirror. Corners of mirror frame are heliarc welded, ground and polish smooth. Galvanized steel back is fastened to frame with concealed screws and equipped with integral horizontal hanging brackets near the top and bottom of the mirror for hanging the mirror and to prevent the mirror from pulling away from the wall. Locking devices secure mirror to concealed wall hanger.
3. Mirror: No. 1 quality, 1/4 inch (6mm) select float glass (standard glass): selected for silvering, electrolytically copper-plated by the galvanic process, and guaranteed for 15 years against silver spoilage. All edges protected by plastic filler strips; back is protected by full-size, shock-absorbing, water-resistant, nonabrasive, 3/16 inch (5mm) thick polyethylene padding.
4. Size: 24 inches W x 48 inches H.

G. **Mop and Broom Holder:**
1. Basis of Design: Bobrick, B-239x34.
2. Mop and Broom Holder with Utility Shelf: 34-inch- long unit fabricated of minimum nominal 0.05-inch- thick stainless steel with shelf; support brackets for wall mounting; four hooks for wiping rags; three spring-loaded, rubber cam-type, mop/broom holders mounted on front of shelf..

H. **Under-Lavatory Guard:** Provide under-lavatory guard where lavatory piping is exposed below the counter or with wall hung lavatories.
1. Basis of Design: Truebro, Inc.
2. Insulating Piping Coverings: White, antimicrobial, molded-vinyl covering for supply and drain piping assemblies intended for use at accessible lavatories to prevent direct contact with and burns from piping. Provide components as required for applications indicated with flip tops at valves that allow service access without removing coverings.

I. **Warm-Air Hand/Hair Dryers**:
1. Basis of Design: Dyson Airblade dB.
2. Hand Dryer: Surface mounted, hands-in, rapid drying hand dryer.
   a. Warranty Period: 10 years.
   b. Controls: Touch-free infra-red activation. Dry time 12 seconds.
   c. Motor: 20,000 rpm motor; 110-120V AC, 12 A, 1400 W.
   d. Cover: Polycarbonate-ABS
   e. Finish: Gray.
   f. Airspeed at aperatures: 420 mph.
   g. Operating Airflow: 74 cfm

J. **Diaper-Changing Station**:
1. Basis-of-Design: Koala KB-200.
2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
3. Engineered to support a minimum of 200-lb static load when opened.
4. Mounting: Surface mounted, with unit projecting not more than 4 inches (100 mm) from wall when closed.
5. Operation: By pneumatic shock-absorbing mechanism.
6. Material and Finish: High-density polyethylene.
   1) Color: As selected by Architect from manufacturer’s full range.
7. Liner Dispenser: Built in.

K. **Clothes Hook**:
1. Basis of Design: Toto, YH960BN.
2. Surface-Mounted Robe Hook
   a. Solid brass with brushed nickel finish.
   b. Size: 2-15/16 inch L x 1-5/16 inch W x 13/16 inch D.

L. **Shower Curtain Rod**:
1. Basis of Design: Bobrick, B-224x36**.**
2. Stainless-Steel Nominal Thickness: Minimum 18-gauge.
3. Mounting: Exposed with manufacturer's standard flanges and anchors.
4. Gripping Surfaces: Smooth, satin finish.
5. Outside Diameter: 1-1/4 inches for heavy-duty applications.

M. **Shower Curtain**:
1. Basis of Design: Plain Weave, Hookless Shower Curtain; Arcs & Angles.
2. Shower Curtain: Water repellent, anti-microbial, 100 percent polyester material with ultrasonic water sheeting bottom hem. Provide with matching “Flex-On” color rings sized for shower curtain rod.
   a. Size: Minimum 6 inches wider than opening by 72 inches high.
   b. Color: As selected by Architect from manufacturer's full range.
   c. Quantity: Provide one (1) shower curtain for each shower as indicated, plus 25 percent extra stock.

N. **Folding Shower Seat**: Provide heavy-duty hinged seat designed to fold up against wall when not in use with stainless-steel support braces, hinges, frame, and fasteners; of all-welded construction; and complying with the following:
   1. Basis of Design: Bobrick, B-5181
   2. Configuration: L-shaped seat, designed for wheelchair access.
   3. Seat Material**:** Phenolic or polymeric composite of slat-type or one-piece construction. Color as selected by Architect from manufacturer's full range.

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DIVISIONS 11 - 21

Not Used

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DIVISION 22 - PLUMBING

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SECTION 22 0100

GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL

A. General Conditions and Division 01 apply to this Division.

1.2 SCOPE

A. Includes -

1. Furnish all labor, materials, and equipment necessary for the completion of the mechanical and plumbing scope of work.
2. Furnish and install all motors specified in this Division and be responsible for the proper operation of electrical powered equipment furnished by this Division.
3. Furnish exact location of electrical connections and information on motor controls to Division 26.
4. Mechanical Contractor shall obtain the services of independent Test and Balance Agency.
5. Placing the air conditioning, heating, ventilating, and exhaust systems into full operation and continuing their operation during each working day of testing and balancing.
6. Making changes in pulleys, belts, and dampers, or adding dampers, as required for the correct balance as recommended by Balancing Contractor at no additional cost to Owner.
7. Air balance, final adjustment and test run.
8. The satisfactory performance of the completed systems is a requirement of this specification.

B. Related Work Specified Elsewhere

1. Conduit, line voltage wiring, outlets, and disconnect switches specified in Division 26.
2. Magnetic starters and thermal protective devices (heaters) not a factory mounted integral part of packaged equipment are specified in Division 26.

1.3 SITE OBSERVATION

A. The Contractor shall examine the site and understand the conditions which may affect the performance of work of this Division before submitting proposals for this work.

B. No subsequent allowance for time or money will be considered for any consequence related to failure to examine existing site conditions.

1.4 DRAWINGS

A. Mechanical drawings show general arrangement of piping, ductwork, equipment, etc; however, locations are to be regarded as shown diagrammatically only. Follow as closely as actual building construction and work of other trades will permit.

B. Because of the small scale of mechanical drawings, it is not possible to indicate all offsets, fittings, and accessories which may be required. Investigate existing structural and finished conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.
If changes in location of piping, equipment, ducts, etc. are required due to lack of coordination of work under this division, such changes shall be made without charge. Contractor shall review drawings with local and state agencies having jurisdiction and any changes required by them shall be brought to the attention of the Engineer prior to bidding or commencement of work. It is understood that while Drawings are to be followed as closely as circumstances permit, this Division will be held responsible for the installation of systems according to the true intent and meaning of the Contract Documents. Anything not clear or in conflict will be explained by making application to the Engineer in writing. Should conditions arise where certain changes would be advisable, secure Owner's and Engineer approval for these changes before proceeding with work.

1.5 COORDINATION OF WORK:

A. Coordinate work of various trades in installing interrelated work. Before installation of mechanical items, make proper provision to avoid interferences in a manner approved by Engineer. Changes required in work specified in Division 22 and 23 caused by neglect to secure approval shall be made at no cost to Owner.

B. Arrange piping, ductwork, and equipment to permit ready access to valves, unions, starters, motors, control components, and to clear openings of doors and access panels. Contractor shall provide all necessary access doors and/or panels to provide complete access to all mechanical equipment, dampers, or accessories. Doors for dampers, etc. shall be minimum 12" x 12" and doors for mechanical equipment shall be minimum 24" x 24".

C. Furnish and install inserts and supports required by Division 22 and 23 unless otherwise noted. Furnish sleeves, inserts, supports, and equipment that are an integral part of other Divisions involved in sufficient time to be built into the construction as the Work proceeds. Locate these items and see that they are properly installed. Expense resulting from improper location or installation of items above shall be borne by Contractor.

D. Be responsible for required digging, cutting, and patching incident to work of this Division and make required repairs afterwards to satisfaction of Owner and Architect. Cut carefully to minimize necessity for repairs to existing work. Do not cut beams, columns, or trusses.

1. Patch and repair walls, floors and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.
2. This Division shall bear expense of cutting, patching, repairing, and replacing of work of other Divisions because of its fault, error, tardiness, or because of damage done by it.
3. Provide the necessary cutting, patching, repairing, and replacing pavements, sidewalks, etc. to permit installation of work of this Division.

E. Adjust locations of piping, ductwork, equipment, etc, to accommodate work from interferences anticipated and encountered. Determine exact route and location of each pipe and cut prior to fabrication.

1. Make offsets, transitions, and changes in direction of piping, ductwork, and electrical raceways as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.

F. Slots and openings through floors, walls and roofs shall be provided by this Division.

G. This Contractor shall schedule his work, store his equipment and materials, and work in harmony with other Contractors so as to not delay or jeopardize the construction.

H. This Division shall coordinate with electrical contractor to insure that all required components of control work are included and fully understood. Any discrepancies shall be called to the attention of the Engineer before completion of bids. No additional cost shall accrue to the Owner as a result of lack of such coordination.

1.6 EQUIPMENT & MATERIALS:

A. Requests for substitution shall be received in writing a minimum of seven days prior to bidding. Prior acceptance shall be by Manufacturer's name only. Items not listed in this specification or subsequent addendums shall not be considered. No oral approvals will be acceptable. Manufacturers listed in this specification are acceptable only for items listed. All other items manufacturer wishes to bid must be prior approved. All equipment shall be subject to final review in accordance with "Project Submittals".

B. Product Approvals -

1. If approval is received to use other than specified items, responsibility for specified capacities and insuring that items to be furnished will fit space available lies with this Division.

2. In the event other than specified equipment is used and will not fit job site conditions, this Division assumes responsibility for replacement with items named in Specification.

C. Use domestic made pipe, pipe fittings, and motors on Project.

D. Motor and equipment name plates as well as applicable UL labels shall be in place when Project is turned over to Owner.

E. Insure that items to be furnished fit spaces available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. Do not scale off drawings.

F. All materials shall be of the best commercial quality obtainable, consistent with specified materials and for the purpose or function intended. Materials shall be new unless specifically excepted.

G. Equipment catalog or model numbers shown define the basic equipment types and quality standard only. Catalog numbers shall not be considered as all inclusive and shall be verified to include all devices, controls, operators, and appurtenances necessary for the satisfactory and complete operation of the equipment.

H. Follow manufacturer's directions in delivery, storage, protection, and installation of equipment and materials.

1. Promptly notify Engineer in writing of conflicts between requirements of Contract Documents and Manufacturer's directions and obtain Engineer’s written instructions before proceeding with work. Contractor shall bear all expenses arising from correcting deficiencies of work that does not comply with Manufacturer's directions or such written instructions.

I. Deliver equipment and material to site and tightly cover and protect against dirt, water, and chemical or mechanical injury but have readily accessible for inspection. Store items subject to moisture damage (such as controls) in a dry, heated space.

1.7 PROJECT SUBMITTALS:

A. Furnish complete catalog data for manufactured items of equipment to be used in the Work to for review within 15 days after award of Contract.

B. Submittal shall include, but not be limited to the following:

1. equipment scheduled
2. balancing contractor
3. insulation
4. grilles, and diffusers
5. automatic temperature controls
6. certificates of guarantee
7. valves
8. plumbing fixtures, accessories, and specialties
9. any item for which more than one manufacturer is mentioned

C. Submit a minimum of five copies of data in binders and index in same order and name as they appear in Specification. - Optional: Provide electronic submittals. Electronic submittals shall be in .pdf format, and shall be compiled into a single file, with bookmarks for each piece of equipment.

1. State sizes, capacities, brand names, motor HP, electrical requirements, accessories, materials, gauges, dimensions, and other pertinent information.
2. List on catalog covers page numbers of submitted items.
3. Underline or highlight applicable data.

D. If material or equipment is not as specified or submittal is not complete, it will be rejected.

E. Catalog data or shop drawings for equipment which are noted as approved shall not supersede Contract Documents.

F. Review comments shall not relieve this Division from responsibility for deviations from Contract Documents unless attention has been called to such deviations in writing at time of submission, nor shall they relieve this Division from responsibility for errors in items submitted.

G. Check work described by catalog data with Contract Documents for deviations and errors.

H. All items other than first named specified equipment shall show and state all exceptions and deviations taken and shall include design calculations and drawing layouts.

I. The Contractor shall review the submittals prior to submission to make sure that the submittals are complete in all details. No submittal will be reviewed which does not bear the contractor's notation that such checking has been made.

J. No partial submittals will be considered unless approved by the Engineer.

K. Manufacturers' names shall be mentioned as acceptable prior to bidding.

L. Contractor shall verify equipment dimensions to fit the spaces provided with sufficient clearance for servicing the equipment.

M. Contractor shall review equipment submittals for compliance with schedules, specifications, and drawing plans and details. Equipment submittal shall show the proper arrangements to suit installation and maintenance such as motor location, access doors, filter removal, piping connections, etc.

N. Equipment submittal sheets shall be clearly marked indicating equipment symbol and exact selection of proposed equipment. Submittals shall clearly indicate name of manufacturer of each item.

O. For unacceptable items, the right shall be reserved to require the first named specified items.

P. Where submittals are sent with any of the above listed information missing or are incomplete they will be returned to the contractor unchecked to be completed and resubmitted. No additional time or money shall be allowed for failure to provide complete submittals on the first review.

Q. If an item requiring submittal review is ordered, purchased, shipped, or installed prior to the submittal review the item shall be removed from the job site and replaced with an approved item at contractors expense.

1.8 CLEANING & FINISHING:

A. Contractor shall, at all times, keep the premises free from waste material and rubbish. Upon completion of this Section of the work, Contractor shall remove all surplus materials and rubbish; clean all spots resulting from the mechanical work from hardware, floors, glass, walls, etc.; do all required patching up and repair all work of other trades damaged by Contractor under this Section of the work, and leave the premises in a clean orderly condition. Clean heating and cooling coils, internally and externally, and replace all air filters prior to final mechanical inspection. Remove rust, plaster, dirt, grease and oil before painting, insulating, or exposing to view the equipment, piping, ductwork, etc. in completed structure. Refinish any damaged surfaces and leave in proper working order at final completion.

1.9 EQUIPMENT SERVICING:

A. Prior to starting mechanical equipment, all motors, bearings and moving parts shall be properly oiled, greased and lubricated as required. Full and adequate maintenance service shall be given and upon completion all equipment shall be cleaned and checked and placed in perfect condition for the Owner.

B. Amount and type of lubricant shall be per manufacturer's specification.

1.10 SUPERVISION:

A. The Contractor shall supervise and direct the work with his best skill and attention. He will be solely responsible for the means, methods, techniques, sequences and procedures of construction. The

Contractor will be responsible to see that the finished work complies accurately with the Contract Documents.

1.11 SAFETY REGULATIONS:

A. Contractor shall provide equipment, supervision, construction, procedures, and everything necessary to assure safety of life or property.

B. Refer also to General Condition and Special Conditions for protection clauses.

1.12 LEAK DAMAGE:

A. Contractor shall be responsible for damages to the work of other Contractors or to the building, or to its contents, people, etc., caused by leaks in any of the equipment or piping installed by him through equipment or material failures, leaking joints or disconnected pipes, fittings, or by overflows and shall make at his own expense all repairs to fixtures, building interior, contents, paint, rugs, furniture, ceiling tile, and equipment so damaged.

1.13 TOOLS AND STORAGE OF EQUIPMENT:

A. The Contractor shall furnish all necessary tools, staging and whatever may be necessary for the installation of this work and shall at all times protect this work and others, and the materials to be used therein from damage by the weather, accident and other causes, and shall repair and make good any damage thus occurring.

1.14 WORKMANSHIP:

A. Workmanship shall be the best quality of its kind for respective industries, trades, crafts and practices and shall be acceptable in every respect to the Owner and Engineer. Nothing contained herein shall relieve the Contractor from performing good work, perfect in all details of construction.

1.15 TEMPORARY FACILITIES:

A. Furnishing of temporary water, space heating, sanitary facilities, drainage lines, light and power will be as specified in Division 01 General Conditions. Contractor shall arrange to bring facilities to required location of premises. All expenses involved shall be paid by the Contractor as described in General and Special Conditions.

1.16 PAINTING BY CONTRACTOR:

A. See section 09900 for painting requirements. See also section 22 and 23 for color code requirements.

B. Painting shall be by persons experienced in painting.

C. All exposed, insulated, and bare piping, equipment, metal stands and supports shall be painted as follows:

1. The prime coat on equipment shall be factory applied. The finish coats shall be applied under Section 09900 of these specifications.
2. All equipment which is to be furnished in finished painted condition by Contractor shall be left without mark, scratch or impairment to finish upon completion and acceptance of job. Any necessary refinishing to match original shall be done by Contractor. Do not paint over name plates, serial numbers or other identifying marks.
3. All new piping shall be painted as required in Section 22 and 23. Paint colors shall conform to color code requirements as specified "Identification of Piping and Equipment".

1.17 EQUIPMENT BASES:

A. Provide reinforced concrete bases under boilers, chillers, pumps, air handling units, and other equipment as necessary or as indicated on the drawings. Coordinate work with Division 03.

B. Bases shall be 6" high, above the finish floor. The base shall extend beyond the equipment 6" in all directions, where possible. Inserts and vibration isolation systems shall be provided and installed by the Mechanical Contractor at the time the concrete is poured to accommodate and anchor the equipment used. Coordinate with vibration isolation manufacturer's requirements and Section 22 and 23. Provide a one inch beveled edge all around.

1.18 BELT GUARDS:

A. Shall be provided, properly enclosing each belt drive system. Guards shall be easily removable, constructed of expanded metal with suitable frames corresponding with SMACNA standard and with tachometer openings. Coordinate with equipment suppliers to avoid duplication of belt guards supplied with equipment. Guards shall comply with OSHA Regulations.

1.19 ELECTRICAL WORK:

A. Power wiring to all electrically driven apparatus shall be done under the electrical contract. See Electrical Specifications.

B. Unless specifically noted otherwise on documents, Electrical Contractor shall furnish and install all magnetic starters including properly sized heaters, and disconnect switches as indicated on drawings or required by code.

C. The Contractor shall verify the proper operation of equipment furnished by him. Costs for repair, replacing, re-wiring and retesting shall be borne by the Contractor without additional costs to the Owner.

D. Motors shall be as specified.

1.20 CONTRACTOR'S USE OF BUILDING EQUIPMENT:

A. The Contractor may use equipment such as electric motors, fans, filters, etc. when permanently installed as part of the project and with the written permission of the Owner. As each piece of equipment is used, maintenance procedures approved by the manufacturer shall be followed, a careful record shall be kept of the time used, maintenance procedure following and of any difficulty experienced with equipment. The Contractor's records on the equipment shall be submitted to the Owner upon acceptance of project. All fan belts and filter media shall be new at the beginning of the Mechanical System Operating Test Run and System Balancing. Wearing surfaces (such as bearings) shall be carefully inspected just prior to acceptance. Any excessive wear noted shall require replacement.

1.21 INSPECTION NOTICE:

A. The following is a basic list of guideline items so that the Architect, district building inspector/Owner's representative can be at job site for these inspections as the building progresses. Mechanical Contractor shall inform these people one week in advance of test time.

1. Water tests on all sewer, waste, and rainwater piping prior to piping being concealed.
2. Pressure tests on all water service piping.
3. Pressure tests on hot, chilled, and condenser water supply and return piping.
4. All duct work prior to installation of finished ceilings, including ductwork pressure testing.
5. The initial start-up of mechanical equipment, etc.
6. Any changes or problems occurring at job site.
7. Inspect all vent flashings on roof prior to roofing.
8. Periodic inspection at their discretion will be made to insure compliance to Contract Documents and codes. Contractor shall provide ladders, access and other assistance as requested during inspections.
9. Control piping pressure tests.
10. Final inspection before giving approval for final payment.

1.22 EXCAVATION AND BACKFILLING:

A. Trench for the underground gas pipe line shall be excavated to the required depth. Rocks, trash, or other debris will not be allowed in trench or backfill and shall be removed before pipe is laid in place. After piping has been tested, inspected and approved, piping shall be backfilled. All landscaping, concrete, etc., damaged by this Contractor shall be replaced by him to the satisfaction of Owner's Representative.

1.23 WARRANTY GUARANTEE:

A. The Contractor shall warrant all materials and equipment to be of quality consistent with specifications as represented by manufacturer's published data.

B. The Contractor shall guarantee that the installation and operation of the equipment shall be free from defects for a period of one year beginning at date of substantial completion and acceptance. The Contractor shall replace or repair any part of the installation that is found to be defective or incomplete within the guarantee period.

C. The one year guarantee on equipment and systems shall commence when equipment has been demonstrated to work and has been accepted. (Example: If an equipment item fails to perform and it takes 9 months after substantial completion to correct, then the guarantee shall commence after the item has been demonstrated to perform and has been accepted.)

D. Substantial completion and acceptance in no way relieves the Contractor from providing the systems and equipment as specified.

1.24 COMPLETION SCHEDULE:

A. Start-up and verification of basic equipment items shall be done prior to the date of substantial completion with sufficient time to allow balancing and adjusting to be performed.

B. At the time of the final inspection a date shall be agreed upon for completion of any remaining items. At least double the estimated cost of the work will be withheld from the Contractor's payment.

1.25 CODE REQUIREMENTS, FEES, AND PERMITS

A. The work shall be installed in accordance with the following applicable codes, ordinances and standards unless otherwise specified. The codes and standards shall include but not be limited to and be of the latest and current editions.

1. American Boiler and Affiliated Industries (AB and AI)
2. American Gas Association (AGA)
3. Air Movement and Control Association (AMCA)
4. American National Standards Institute (ANSI)
5. Air Conditioning & Refrigeration Institute (ARI)
6. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) - ASHRAE 90.1-2010
7. American Society of Mechanical Engineers (ASME)
8. American Society of Testing Materials (ASTM)
9. American Standards Association (ASA)
10. American Water Works Association (AWWA)
11. American Welding Society (AWS)
12. Associated Air Balance Council (AABC)
13. Heat Exchange Institute (HEI)
14. Hydraulic Institute (HI)
15. BR
16. National Electrical Code (NEC)
17. National Fire Protection Association (NFPA)
18. Sheet Metal and Air Conditioning contractors National Association (SMACNA)
19. Underwriters Laboratories (UL)

20. International Building Code (IBC) 2012 Ed
21. International Mechanical Code (IMC) 2012 Ed
22. International Plumbing Code (IPC) with Utah Amendments 2012 Ed
23. International Energy Conservation Code (IECC) 2012 Ed
24. Utah State Safety Orders (OSHA/UOSH)
25. Utah Fire Rating Bureau
26. Utah Boiler and Pressure Vessel Law
27. Utah Air Conservation Regulations/Waste Disposal regulations.
28. ASHRAE Ventilation STD.62-2010

B. Should drawings conflict with any code, the code shall govern. If drawings and specifications establish a quality exceeding the code, the drawings and specifications shall govern. If conflicts do exist among the drawings, specifications and codes, the same shall be brought to the attention of the Engineer in writing prior to bidding, otherwise Contractor shall comply with applicable codes.

C. The latest edition of all codes shall be used.

D. Contractor shall give all notices, obtain all necessary permits, file necessary plans, prepare documents and obtain approvals, and pay all fees required for completion of the mechanical and plumbing work outlined in this Division of the specifications and shown on the Mechanical Drawings.

1.26 OPERATION AND MAINTENANCE MANUAL FOR MECHANICAL SYSTEMS

A. Upon completion of work and before final payment, Contractor shall furnish and deliver to the Owner, through the Engineer, installation, operation and maintenance manuals with instructions for all new materials and equipment used in the building. The contractor shall provide three (3) hard copies of the manuals, and three (3) CD's with electronic copies of the manuals. Electronic information shall be .PDF format. The CD's shall include the same information as the hard copies, and shall be organized in the same manner with electronic bookmarks for each section. CD case and the CD itself shall be labeled the same as the hard copies of the manuals.

B. Bind Operation and Maintenance Manual for Mechanical Systems in a hard-backed piano hinge loose-leaf binder with strong sturdy cover. The project name shall be on the spine and the front of the binder. The front of the binder shall include the following information:

OPERATION
AND
MAINTENANCE
MANUAL
for MECHANICAL SYSTEMS of
(Name of Project)
(Location of Project)
(Date of Project Award)
(Name of Architect)

C. Introduction

1. Title page including name of project, project number, date awarded and date of substantial completion.
2. Second page shall contain the names, phone numbers and addresses of Architect, Consulting Engineers, Mechanical Contractor, and General Contractor.

3. Third page shall include a Table of Contents for the entire manual.

D. First Section - Summary information including:

1. First page shall contain the contractor's warranties.
2. Second page shall contain a list of names, addresses and phone numbers of contractors and all sub-contractors and work to which each was assigned.
3. Final page or pages shall contain an equipment list. The list shall contain each item of equipment or material for which a submittal was required giving ID or tag no as contained on the drawings make and model No. Serial No. Identification No. Location in building, function along with the name, address, and phone number of the supplier.

E. Second Section - Mechanical Equipment O&M data including:

1. Mechanical maintenance schedule, including a lubrication list when necessary.
2. Mechanical Equipment Operation and Maintenance Data including:

    a. Equipment descriptions
    b. Detailed installation instruction, operating and maintenance instructions. Instructions include in a step by step manner identifying start-up, operating, shutdown and emergency action sequence sufficiently clear so a person unfamiliar with the equipment could perform its operations.
    c. Equipment drawings, performance curves, operating characteristics, etc.
    d. Name addresses and phone number of manufacturer, fabricator and local vender clearly printed or stamped on cover.
    e. Complete parts listing which include catalog number, serial number, contract number or other accurate provision for ordering replacement and spare parts.
    f. Certified drawings, where applicable, showing assembly of parts and general dimensions.

3. Approved Mechanical submittals

F. Third Section - Plumbing Equipment O&M data including:

1. Section shall contain general product catalog cuts, as well as exploded view drawings with parts lists for all valves and other items with multiple parts.
2. Approved Plumbing submittals

G. Fourth Section - Controls O&M data including:

1. Sequence of Operation
2. Description of each operating system included location of switches, breakers, thermostats, and control devices. Provide a single line diagram, showing set points, normal operating parameters for all loads, pressures, temperatures and flow check points; Describe all alarms and cautions for operation.
3. Provide schematic control diagrams, panel diagrams, wiring diagrams, etc. for each separate fan system, chilled water system, hot water system, exhaust air system**,** pumps, etc. Each control diagram shall show a schematic representation of mechanical equipment and location of start-stop switches, insertion thermostats, thermometers, pressure gauges, automatic valves, etc. The correct reading for each control instrument shall be marked on the diagram.

H. The Fifth Section shall contain a complete air and water test and balance report. The report shall contain the name, address and phone number of the agency. It shall also include:

1. Floor plans showing all air openings and thermometer locations clearly marked and cross referenced with data sheets. Format may be 8 1/2 x 11 or 11x14 if legible.
2. Data sheets showing amount of air and water at each setting. See sections 230593.
3. List of equipment with date of last calibration.

I. Drawings and reproducible masters of drawings as required in individual specification sections, are not to be bound in volumes but are to be delivered separate with the maintenance manuals.

J. See the following checklist for assistance in assembling manual:

Item #	Description	Y, N, or NA
1.	3 ring heavy duty binder with Project name, number and date on cover and project name on spine.	
2.	O&M manual on CD (with label on CD matching label on manual). Electronic copy shall be a PDF file with bookmarks that match the tabs in the hard copy.	
3.	Title Page [including project name, number, address, date awarded, date of substantial completion]	
4.	Second Page Contact List [including architect (if applicable), mechanical engineer, mechanical contractor, and general contractor (if applicable)]	
5.	Table of Contents	
6.	**Section 1 - Summary**	
A.	Warranty	
B.	Mechanical's Sub-contractor List	
C.	Vendor List	
D.	Equipment List	
7.	**Section 2 – Mechanical Equipment**	
A.	Maintenance Schedule (including lubrication list)	
B.	Mechanical Equipment O&M Data (for each piece of equipment submitted) per specifications	
C.	Approved mechanical submittals	
8.	**Section 3 – Plumbing Equipment**	
A.	Plumbing equipment O&M data	
B.	Approved plumbing submittals	
9.	**Section 4 - Controls**	
A.	Sequence of Operation	
B.	Controls diagrams	
C.	Controls Equipment	
10.	**Section 5 – Test and Balance Report**	
A.	Complete Test and Balance Report per specifications	

1.27 OPERATION AND MAINTENANCE INSTRUCTIONS

A. Contractor shall instruct building maintenance personnel in the operation and maintenance of the installed mechanical systems utilizing the Operation and Maintenance Manual when so doing.

B. Minimum instruction periods shall be as follows -

1. Mechanical - Two hours.
2. Plumbing - Two hours.
3. Temperature Control - Two hours.

C. Instruction periods shall occur before final site observation when systems are properly working and before final payment is made.

D. None of these instructional periods shall overlap each other.

E. An additional four hours of instruction will be provided by each contractor, after 60 days of system operation by owner to insure proper system operation and answer questions.

1.28 RECORD DRAWINGS

A. Contractor shall keep an up-to-date set of mechanical and plumbing drawings in his custody showing all changes in red, clearly defined and neatly drafted by him. At the end of construction, he shall turn these drawings over to the Engineer. Record drawings must be completed and submitted prior to final site observation

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PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

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SECTION 22 0500

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Mechanical demolition.
7. Equipment installation requirements common to equipment sections.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Dielectric fittings.
2. Mechanical sleeve seals.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

B. All materials, piping, etc. shall be new, and domestically made of the best commercial quality obtainable, consistent with specified materials and for the purpose or function intended unless specifically approved in writing prior to bid.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 and 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Refer to individual Division 22 and 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

2.3 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Available Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.

c. Eclipse, Inc.
d. Epco Sales, Inc.
e. Hart Industries, International, Inc.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Industries, Inc.; Wilkins Div.
h. Prior Approved Equal.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.
e. Linkseal.
f. Prior Approved Equal.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

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

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

E. PVC Pipe: ASTM D 1785, Schedule 40.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Stamped-Steel Type: With set screw or spring clip**s** and chrome-plated finish.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION

A. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

C. Coordinate with controls contractor prior to removal of any control devices.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 and 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Drawings do not show every offset, or bend that may be required. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors where indicated on drawings and where penetrating will be visible to public.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint.

N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 and 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

END OF SECTION

SECTION 220523

GENERAL- DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following general-duty valves:

1. Bronze ball valves.
2. Ferrous-alloy ball valves.
3. Ferrous-alloy butterfly valves.
4. Bronze check valves.
5. Ferrous-alloy wafer check valves.
6. Chainwheel actuators.

B. Related Sections include the following:
1. Division 22 and 23 Section "Mechanical Identification" for valve tags and charts.
2. Division 22 and 23 Section "HVAC Instrumentation and Controls" for control valves and actuators.
3. Division 22 and 23 piping Sections for specialty valves applicable to those Sections only.

1.3 DEFINITIONS

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NRS: Nonrising stem.
4. OS&Y: Outside screw and yoke.
5. PTFE: Polytetrafluoroethylene plastic.
6. SWP: Steam working pressure.
7. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.5 QUALITY ASSURANCE

A. ASME Compliance: ASME B31.9 for building services piping valves.

1. Exceptions: Domestic hot- and cold-water piping valves unless referenced.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

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

2.2 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

C. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.

D. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.

E. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

G. Valve Actuators:

1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
2. Gear Drive Operator: For quarter-turn valves NPS 8 and larger.
3. Handwheel: For valves other than quarter-turn types.
4. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
5. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.

H. Valves in Insulated Piping: Valves shall have 2-inch stem extensions and the following features:

1. Gate Valves: Shall be rising-stem type.
2. Ball Valves: Shall have extended operating handle of non-thermal-conductive material, protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation, and memory stops that are fully adjustable after insulation is applied.

    a. Manufactures: NIBCO Nib-seal handle extension or a comparable product by one of the following:

        1) Conbraco Industries, Inc.; Apollo Div.
        2) American.
        3) Crane.
        4) Grinnel.
        5) Kitz.
        6) Watts.
        7) Prior approved equal.

3. Butterfly Valves: Shall have extended necks.

I. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

J. Valve Grooved Ends: AWWA C606.

K. Solder Joint: With sockets according to ASME B16.18.

1. Caution: Use solder with melting point below 840 deg F for angle, check, gate, and globe valves; below 421 deg F for ball valves.

L. Threaded: With threads according to ASME B1.20.1.

M. Valve Bypass and Drain Connections: MSS SP-45.

2.3 BRONZE BALL VALVES

A. Bronze Ball Valves, General: MSS SP-110 and have bronze body complying with ASTM B 584, except for Class 250 which shall comply with ASTM B 61, full-depth ASME B1.20.1 threaded or solder ends, and blowout-proof stems.

B. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: Chrome-plated bronze ball and bronze stem and; reinforced TFE seats; threaded body packnut design (no threaded stem designs allowed) with adjustable stem packing, solder or threaded ends; and 150 psig SWP 600-psigCWP rating.

1. Manufacturers: NIBCO Model S-585-70 or T-585-70, or a comparable product by one of the following:

a. NIBCO Model S-585-70 or T-585-70
b. American Valve, Inc.
c. Conbraco Industries, Inc.; Apollo Div.
d. Crane Co.; Crane Valve Group; Jenkins Valves.
e. Crane Co.; Crane Valve Group; Stockham Div.
f. Grinnell Corporation.
g. Kitz Corporation of America.
h. NIBCO INC.
i. Watts Industries, Inc.; Water Products Div.

C. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel vented ball and stem, reinforced TFE seats, threaded body packnut design (no threaded stem designs allowed) with adjustable stem packing, soldered or threaded ends; 150 psig SWP and 600-psig CWP ratings.

1. Manufacturers: NIBCO Model S-585-70-66 or T-585-70-66, or a comparable product by one of the following:

a. Conbraco Industries, Inc.; Apollo Div.
b. American Valve, Inc.
c. Conbraco Industries, Inc.; Apollo Div.
d. Crane Co.; Crane Valve Group; Jenkins Valves.
e. Crane Co.; Crane Valve Group; Stockham Div.
f. Grinnell Corporation.
g. Kitz Corporation of America.
h. NIBCO INC.
i. Watts Industries, Inc.; Water Products Div.

2.4 FERROUS-ALLOY BALL VALVES

A. Ferrous-Alloy Ball Valves, General: MSS SP-72, with ASTM A-216 Type WCB, carbon-steel body; ASTM A-351, Type CF8M vented stainless-steel ball; and ASTM A-276, Type 316 stainless-steel stem; fire rated according to API 607 (4th edition); and having flanged ends and blowout-proof stem.

B. Class 150, Full-Port, Ferrous-Alloy Ball Valves: Split-body construction, carbon-filled TFE seats; 285 psig CWP rating.

1. Manufacturers:

a. NIBCO Model F-515-CS-F-66-FS.
b. American Valve, Inc.
c. Conbraco Industries, Inc.; Apollo Div.
d. Cooper Cameron Corp.; Cooper Cameron Valves Div.
e. Crane Co.; Crane Valve Group; Stockham Div.
f. Foster Valve Co.
g. Hammond Valve.
h. Jomar International, LTD.
i. Kitz Corporation of America.
j. Milwaukee Valve Company.
k. Watts.

2.5 FERROUS-ALLOY BUTTERFLY VALVES

A. Ferrous-Alloy Butterfly Valves, General: MSS SP-67, for bubble-tight shutoff, extended-neck for insulation, disc and lining suitable for potable water, unless otherwise indicated, and with the following features:

1. Full lug, grooved and flanged valves shall be suitable for bi-directional dead end service at full rated pressure without the use or need of a downstream flange. Valves NPS 12 and smaller shall not have exposed stem to disc fasteners and no exterior mounted fasteners to hold the liner.
2. Valve sizes NPS 2 through NPS 6 shall have lever lock operator; valve sizes NPS 8 and larger shall have weatherproof gear operator.

B. Single-Flange, 150-psig CWP Rating, Aluminum-Bronze Disc, EPDM Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, one- or two-piece Type 416 stainless-steel stem, bronze bushing, aluminum-bronze disc, and phenolic-backed EPDM seat (liner) attached to the body.

1. Manufacturers: NIBCO Model LD-1000-5, or a comparable product by one of the following:

a. Bray International, Inc.
b. Cooper Cameron Corp.; Cooper Cameron Valves Div.
c. Crane Co.; Crane Valve Group; Center Line.
d. Crane Co.; Crane Valve Group; Jenkins Valves.
e. Crane Co.; Crane Valve Group; Stockham Div.
f. Dover Corp.; Dover Resources Company; Norriseal Div.
g. General Signal; DeZurik Unit.
h. Grinnell Corporation.
i. Hammond Valve.
j. Kitz Corporation of America.
k. Legend Valve & Fitting, Inc.
l. Metraflex Co.
m. Milwaukee Valve Company.
n. Mueller Steam Specialty.
o. Process Development & Control.
p. Red-White Valve Corp.
q. Techno Corp.
r. Tyco International, Ltd.; Tyco Valves & Controls.
s. Watts Industries, Inc.; Water Products Div.

C. Single-Flange, 150-psig CWP Rating, Aluminum-Bronze Disc, BUNA Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, one- or two-piece Type 416 stainless-steel stem, bronze bushing, aluminum-bronze disc, and phenolic-backed BUNA seat (liner) attached to the body.

1. Manufacturers: NIBCO Model LD-1100-5, or a comparable product by one of the following:

a. Bray International, Inc.
b. Cooper Cameron Corp.; Cooper Cameron Valves Div.
c. Crane Co.; Crane Valve Group; Center Line.
d. Crane Co.; Crane Valve Group; Jenkins Valves.
e. Crane Co.; Crane Valve Group; Stockham Div.
f. Dover Corp.; Dover Resources Company; Norriseal Div.
g. General Signal; DeZurik Unit.
h. Grinnell Corporation.
i. Hammond Valve.
j. Kitz Corporation of America.
k. Legend Valve & Fitting, Inc.
l. Metraflex Co.
m. Milwaukee Valve Company.
n. Mueller Steam Specialty.
o. Process Development & Control.
p. Red-White Valve Corp.
q. Techno Corp.
r. Tyco International, Ltd.; Tyco Valves & Controls.
s. Watts Industries, Inc.; Water Products Div.

D. Single-Flange, 200-psig CWP Rating, Aluminum-Bronze Disc, EPDM Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, one-piece Type 416 stainless-steel stem, copper bushing, fasteners and pins shall not be used to attach stem, to disc, no pins or fasteners in waterway, aluminum-bronze disc, and molded-in EPDM seat (liner).

1. Manufacturers: NIBCO Model LD-2000-3/5, or a comparable product by one of the following:

a. Bray International, Inc.
b. Cooper Cameron Corp.; Cooper Cameron Valves Div.
c. Crane Co.; Crane Valve Group; Center Line.
d. Crane Co.; Crane Valve Group; Jenkins Valves.
e. Crane Co.; Crane Valve Group; Stockham Div.
f. Dover Corp.; Dover Resources Company; Norriseal Div.
g. General Signal; DeZurik Unit.
h. Grinnell Corporation.
i. Hammond Valve.
j. Kitz Corporation of America.
k. Legend Valve & Fitting, Inc.
l. Metraflex Co.
m. Milwaukee Valve Company.
n. Mueller Steam Specialty.
o. Process Development & Control.
p. Red-White Valve Corp.
q. Techno Corp.
r. Tyco International, Ltd.; Tyco Valves & Controls.
s. Watts Industries, Inc.; Water Products Div.

E. Single-Flange, 200-psig CWP Rating, Aluminum-Bronze Disc, BUNA Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, one-piece Type 416 stainless-steel stem, copper bushing, fasteners and pins shall not be used to attach stem to disc, no pins or fasteners in waterway, aluminum-bronze disc, and molded-in BUNA seat (liner).

1. Manufacturers: NIBCO Model LD-2100-3/5, or a comparable product by one of the following:

    a. Bray International, Inc.
    b. Cooper Cameron Corp.; Cooper Cameron Valves Div.
    c. Crane Co.; Crane Valve Group; Center Line.
    d. Crane Co.; Crane Valve Group; Jenkins Valves.
    e. Crane Co.; Crane Valve Group; Stockham Div.
    f. Dover Corp.; Dover Resources Company; Norriseal Div.
    g. General Signal; DeZurik Unit.
    h. Grinnell Corporation.
    i. Hammond Valve.
    j. Kitz Corporation of America.
    k. Legend Valve & Fitting, Inc.
    l. Metraflex Co.
    m. Milwaukee Valve Company.
    n. Mueller Steam Specialty.
    o. Process Development & Control.
    p. Red-White Valve Corp.
    q. Techno Corp.
    r. Tyco International, Ltd.; Tyco Valves & Controls.
    s. Watts Industries, Inc.; Water Products Div.

F. Grooved-End, Ferrous-Alloy Butterfly Valves with EPDM-Encapsulated Ductile-Iron Disc: Ductile-iron with grooved or shouldered ends, polyamide coating inside and outside, two-piece Type 416 stainless-steel stem, PTFE bronze sintered on steel bushing, fasteners and pins shall not be used to attach stem to disc, no pins or fasteners in waterway, and 300-psig CWP Rating for Valves NPS 2 through NPS 8, 200 psig CWP Rating for Valves NPS 10 through NPS 12.

1. Manufacturers: NIBCO Model GD-4765-3/5, or a comparable product by one of the following:

    a. Central Sprinkler Co.; Central Grooved Piping Products.
    b. Grinnell Corporation.
    c. Hammond Valve.
    d. McWane, Inc.; Kennedy Valve Div.
    e. Milwaukee Valve Company.
    f. Mueller Steam Specialty.
    g. Victaulic Co. of America.

G. Grooved-End, Ferrous-Alloy Butterfly Valves with BUNA-Encapsulated Ductile-Iron Disc: Ductile-iron with grooved or shouldered ends, polyamide coating inside and outside, two-piece Type 416 stainless-steel stem, PTFE bronze sintered on steel bushing, fasteners and pins shall not be used to attach stem to disc, no pins or fasteners in waterway, and 300-psig CWP Rating for Valves NPS 2 through NPS 8, 200 psig CWP Rating for Valves NPS 10 through NPS 12.

1. Manufacturers: NIBCO Model GD-4775-3/5, or a comparable product by one of the following:

    a. Central Sprinkler Co.; Central Grooved Piping Products.
    b. Grinnell Corporation.

c. Hammond Valve.
d. McWane, Inc.; Kennedy Valve Div.
e. Milwaukee Valve Company.
f. Mueller Steam Specialty.
g. Victaulic Co. of America.

2.6 BRONZE CHECK VALVES

A. Bronze Check Valves, General: MSS SP-80.

B. Class 125, Bronze, Lift Check Valves with TFE Disc: ASTM B-584 bronze body and integral seat with soldered or threaded end connections, and having 250-psig CWP rating.

1. Manufacturers: NIBCO Model S-480-Y or T-480-Y, or a comparable product by one of the following:

a. Cincinnati Valve Co.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Stockham Div.
d. Red-White Valve Corp.
e. Walworth Co.

C. Class 125, Bronze, Lift Check Valves with BUNA Disc: ASTM B-584 bronze body and integral seat with nonmetallic BUNA disc, soldered or threaded end connections, and having 250-psig CWP rating.

1. Manufacturers: NIBCO Model S-480 or T-480, or a comparable product by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Powell, Wm. Co.

D. Class 300, Bronze, Swing Check Valves with Bronze Disc: ASTM B-61 bronze body and seat with regrinding-type bronze disc, Y-pattern design, threaded end connections, and having 600 psig CWP rating.

1. Manufacturers: NIBCO Model T-473-B, or a comparable product by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Powell, Wm. Co.

E. Class 125, Bronze, Swing Check Valves with TFE Disc: ASTM B-62 bronze body and seat with TFE disc in bronze seat holder, Y-pattern design, soldered or threaded end connections, and having 200 psig CWP rating.

1. Manufacturers: NIBCO Model S-413-Y or T-413-Y, or a comparable product by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Powell, Wm. Co.

F. Class 125, Bronze, Swing Check Valves with BUNA Disc: ASTM B-62 bronze body and seat with BUNA disc in bronze seat holder, Y-pattern design, soldered or threaded end connections, and having 200 psig CWP rating.

1. Manufacturers: NIBCO Model S-413-W or T-413-W, or a comparable product by one of the following:

    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Powell, Wm. Co.

G. Class 150, Bronze, Swing Check Valves with TFE Disc: ASTM B-62 bronze body and seat with TFE disc in bronze seat holder, Y-pattern design, soldered or threaded end connections, and having 300 psig CWP rating.

1. Manufacturers: NIBCO Model S-433-Y or T-433-Y, or a comparable product by one of the following:

    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Powell, Wm. Co.

2.7 DUAL-PLATE, IRON, WAFER OR GROOVED CHECK VALVES

A. Dual-Plate, Iron, Wafer or Grooved Check Valves, General: ANSI B16.1, spring loaded.

B. Dual-Plate, Iron, Wafer or Grooved Check Valves: Class 125, cast-iron, flangeless body with dual, bronze discs; stainless-steel spring and stop pin; BUNA seat; and having 200 psig CWP rating.

1. Manufacturers: NIBCO Model W-920-W or G-920-W, or a comparable product by one of the following:

    a. Metraflex Co.
    b. Val-Matic Valve & Mfg. Corp.
    c. Crane.
    d. Grinnel.
    e. Mueller.
    f. Watts.

2.8 CHAINWHEEL ACTUATORS

A. Available Manufacturers:

B. Manufacturers:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries, Inc.
3. Prior approved equal.

C. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Sprocket Rim with Chain Guides: [**Ductile iron**] [**Cast iron**] [**Aluminum**] [**Bronze**], of type and size required for valve.[**Include zinc coating.**]
2. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
3. Chain: [**Hot-dip, galvanized steel**] [**Brass**] [**Stainless steel**], of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

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

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball or butterfly valves.
2. Throttling Service: Angle, ball, butterfly, or globe valves.
3. Pump Discharge: Spring-loaded, lift-disc or dual-plate check valves; lever and weight swing check valves; or lever and spring swing check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Chilled-Water Piping: Use the following types of valves:

1. Ball Valves, NPS 2 and Smaller: Two -piece, full port, stainless-steel trim, bronze.
2. Ball Valves, NPS 2-1/2 and Larger: Class 150, full -port, ferrous alloy.
3. Butterfly Valves, NPS 2 to NPS 12: Single-flange, full lug, [200-psig CWP rating, bronze disc, EPDM liner, ferrous alloy.
4. Grooved-End, Ductile-Iron Butterfly Valves, NPS 2 to NPS 8 300-psig CWP rating, EPDM- encapsulated ductile-iron disc.
5. Dual-Plate Check Valves, NPS 2-1/2 and Larger: Wafer, iron.

D. Domestic Water Piping: Use the following types of valves:

1. Ball Valves, NPS 2 and Smaller: Two -piece, full port, stainless-steel trim, bronze.
2. Ball Valves, NPS 2-1/2 and Larger: Class 150, full -port, ferrous alloy.
3. Butterfly Valves, NPS 2 to NPS 12 Single-flange, full lug, 200-psig CWP rating, bronze disc, EPDM liner, ferrous alloy.

4. Lift Check Valves, NPS 2 and Smaller: Class 125 , bronze with TFE disc.

E. Heating Water Piping: Use the following types of valves:

1. Ball Valves, NPS 2 and Smaller: Two -piece, full port, stainless-steel trim, copper alloy.
2. Ball Valves, NPS 2-1/2 and Larger: Class 150, full -port, ferrous alloy.
3. Butterfly Valves, NPS 2 to NPS 12 Single-flange, full lug, 200-psig CWP rating, bronze disc, EPDM liner, ferrous alloy.
4. Grooved-End, Ductile-Iron Butterfly Valves, NPS 2 to NPS 8: 300-psig CWP rating, EPDM- encapsulated ductile-iron disc.
5. Grooved-End, Ductile-Iron Butterfly Valves, NPS 10 to NPS 12: 200-psig CWP rating, EPDM- encapsulated ductile-iron disc.
6. Dual-Plate Check Valves, NPS 2-1/2 and Larger: Wafer, iron.

F. Select valves, except wafer and flangeless types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for heating hot water.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged [**soldered or threaded**] ends.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.
7. For Grooved-End, [**Copper Tubing**] [**and**] [**Steel Piping**]: Valve ends may be grooved. Do not use for steam or steam condensate piping.

3.3 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 22 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe. Butterfly valves may be installed with stem horizontal to allow support for the disc and the cleaning action of the disc.

E. Install valves in position to allow full stem movement.

F. Install chainwheel operators on valves [**NPS 4**] <**Insert other**> and larger and more than [**84 inches**] <**Insert other**> above floor. Extend chains to [**60 inches**] <**Insert other**> above finished floor elevation.

G. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

H. Butterfly valves shall be installed with stems horizontal.

3.4 JOINT CONSTRUCTION

A. Refer to Division 22 and 23 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 ADJUSTING

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

END OF SECTION 220523

SECTION 22 0548

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Freestanding and restrained spring isolators.
3. Seismic snubbers.
4. Restraining braces and cables.

1.3 SCOPE

A. Provide letter of design intent.

B. Provide full set of seismic submittals.

C. Provide a minimum of 2 on site observations.

D. Provide final letter of compliance completion.

1.4 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.5 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

1. Basic Wind Speed: Per owner's design standards.
2. Building Classification Category: As defined in the IBC.
3. Minimum 10 lb/sq. ft. multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

B. Seismic-Restraint Loading:

1. Site Class: As defined in the IBC.

2. Assigned Seismic Use Group or Building Category: As defined in the IBC.

    a. Component Importance Factor: 1.0.

1.6 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

    a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.
    b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Letter of Design intent, stating company, design criteria, compliance with specifications and only exceptions that will apply. Letter shall be stamped and signed by a licensed and qualified professional engineer in this jurisdiction.

C. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic and wind forces required to select vibration isolators, seismic and wind restraints, and for designing vibration isolation bases.

    a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 22 and 23 Sections for equipment mounted outdoors.

2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
4. Seismic- and Wind-Restraint Details:

    a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
    b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacing's. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Division 22 and 23 Sections for equipment mounted outdoors.
d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

D. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

E. Welding certificates.

F. Qualification Data: For professional engineer and testing agency.

G. Field quality-control test reports.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

E. Provide a minimum of 2 site observations, and additional observations if required.

F. Upon project completion provide a final letter of acceptance for seismic restraints system and installation.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

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

1. Amber/Booth Company, Inc.
2. Vibro-acoustics.

3. ISAT
4. Mason Industries.
5. Gripple.
6. Prior approved equal.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene or rubber.

C. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.2 SEISMIC-RESTRAINT DEVICES

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

1. Amber/Booth Company, Inc.
2. Hilti, Inc.
3. ISAT
4. Kinetics Noise Control.
5. Mason Industries.
6. Vibro-acoustics.
7. Gripple.
8. Unistrut; Tyco International, Ltd.
9. Prior approved equal.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.

D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

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

F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.

G. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

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

K. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic- and wind-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic- and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

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

H. Drilled-in Anchors:

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

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 23 Section "Hydronic Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Leave a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.

4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

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

C. Adjust air-spring leveling mechanism.

D. Adjust active height of spring isolators.

E. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-mounting systems. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION

SECTION 22 0553

MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following mechanical identification materials and their installation:

1. Equipment nameplates.
2. Equipment signs.
3. Access panel and door markers.
4. Pipe markers.
5. Warning tags.

1.3 SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Valve numbering scheme.

D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:

a. Manufacturer, product name, model number, and serial number.
b. Capacity, operating and power characteristics, and essential data.
c. Labels of tested compliances.

2. Location: Accessible and visible.
3. Fasteners: As required to mount on equipment.

B. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Data: Instructions for operation of equipment and for safety procedures.
2. Engraving: Manufacturer's standard letter style, 1/4” or larger with terms to match equipment identification.
3. Thickness: 1/8 inch, unless otherwise indicated.
4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

C. Access Panel and Door Markers: 1/16” thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8” center hole for attachment.

1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

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

a. Bradley.
b. Kolbi.
c. Prior approved.

2. Colors: Comply with ASME A13.1, unless otherwise indicated.
3. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
4. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
5. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
6. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 22 and 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:

1. Fuel-burning units, including boilers, furnaces, heaters, etc.
2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
4. Fans, blowers, primary balancing dampers, and mixing boxes.
5. Packaged HVAC central-station and zone-type units.

B. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.

1. Identify mechanical equipment with black equipment markers with white lettering.
2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
4. Include signs for the following general categories of equipment:

    a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    b. Fuel-burning units, including boilers, furnaces, heaters, etc.
    c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
    d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
    e. Fans, blowers, primary balancing dampers, and mixing boxes.
    f. Packaged HVAC central-station and zone-type units.
    g. Tanks and pressure vessels.
    h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

C. Install access panel markers with screws on equipment access panels.

3.3 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

C. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.4 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.5 CLEANING

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

END OF SECTION

SECTION 22 0700

HVAC AND PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Insulation Materials:

a. Mineral fiber.

2. Insulating cements.
3. Adhesives.
4. Lagging adhesives.
5. Factory-applied jackets.
6. Field-applied jackets.
7. Tapes.
8. Securements.
9. Corner angles.

B. Related Sections:

1. Division 23 Section "Metal Ducts" for duct liners.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Qualification Data: For qualified Installer.

C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 and 23 Section "Hangers and Supports."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Duct insulation shall have a minimum R value = 5 for installation in an unconditioned space, and a minimum R value = 8 for installation outdoors. Provide a weather protective sheet metal jacket for outdoor installation.

2. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; All-Service Duct Wrap.
f. Prior approved equal.

G. Mineral-Fiber, Preformed Pipe Insulation:

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

a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000 Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.
f. Prior approved equal.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

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

a. Insulco, Division of MFS, Inc.; Triple I.
b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
c. Prior approved equal.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

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

a. Childers Products, Division of ITW; CP-127.
b. Foster Products Corporation, H. B. Fuller Company; 85-60/ 85-70.
c. Marathon Industries, Inc.; 225.
d. Mon-Eco Industries, Inc.; 22-25.
e. Prior approved equal.

2.4 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

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

a. Childers Products, Division of H.B. Fuller; CR 50 AHV2.
b. Foster Products Corporation, H. B. Fuller Company; 30-36.
c. Vimasco Corporation; 713 and 714.
d. Prior approved equal.

2. Service Temperature Range: Minus 50 to plus 180 deg F.
3. Color: White.

2.5 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.6 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

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

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.

d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
e. Prior approved equal.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

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

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
b. Compac Corp.; 110 and 111.
c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
e. Prior approved equal.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
8. Adhesion: 64 ounces force/inch in width.
9. Elongation: 500 percent.
10. Tensile Strength: 18 lbf/inch in width.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

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

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
b. Compac Corp.; 120.
c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
d. Venture Tape; 3520 CW.
e. Prior approved equal.

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

2.7 SECUREMENTS

A. Bands:

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

a. Childers Products; Bands.

b. PABCO Metals Corporation; Bands.
c. RPR Products, Inc.; Bands.
d. Prior approved equal.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

2.8 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

B. Surface Preparation: Clean and prepare surfaces to be insulated.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

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

3.8 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return, Air.
4. Indoor, exposed return, Air.
5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
6. Indoor, concealed exhaust.
7. Indoor, exposed exhaust.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

B. Concealed, low pressure, round rectangular, and flat-oval exhaust-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

C. Rectangular, low pressure, supply-air duct insulation shall be lined per Section “Metal Ducts”.

D. Rectangular, return-air duct insulation shall be lined per Section “Metal Ducts”.

E. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

F. Exposed or medium pressure, round and flat-oval, supply-air, and return air duct insulation shall be a perforated linear. See Section “Metal Ducts”.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.

2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
4. Vertical roof drain piping.

C. Piping System insulation:

1. Hydronic Piping - Mineral Fiber, per chart.
2. Domestic Cold Water Piping -Mineral Fiber, ½"
3. Domestic Hot Water Piping -Mineral Fiber, per chart
4. Horizontal Roof Drain Piping - Mineral Fiber, 1/2".
5. Refrigerant Piping - Flexible elastomeric, 1".

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Minimum Pipe Insulation Thickness from ANSI/ASHRAE/IESNA Standard 90.1-2010, with modifications per 2012 IECC

Fluid Operating Temperature Range and usage (F°)	Insulation Conductivity		Nominal Pipe or Tube Size (inches)				
	Conductivity Btu-in./(h-ft^2-F°)	Mean Rating Temp. F°	<1	1 to <1-1/2	1-1/2 to <4	4 to <8	≥8
Heating Systems (Steam, Steam Condensate, and Hot Water)							
>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	0.21-0.28	100	1.0	1.0	1.5	1.5	1.5
Cooling Systems (Chilled Water, Brine, and Refrigerant)							
40-60	0.21-0.27	75	0.5	0.5	1.0	1.0	1.0
<40	0.20-0.26	50	0.5	1.0	1.0	1.0	1.5

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:

1. PVC: 20 mils thick.

D. Minimum Pipe Insulation Thickness from ANSI/ASHRAE/IESNA Standard 90.1-2010, with modifications per 2012 IECC

3.13 DUCT INSULATION SCHEDULE

A. Minimum Duct Insulation R-Value, Cooling and Heating Supply Ducts and Return Ducts ANSI/ASHRAE/IES Standard 90.1-2010.

Duct Location							
Climate Zone	**Exterior**	**Ventilated Attic**	**Unvented Attic Above Insulated Ceiling**	**Unvented Attic with Roof Insulation**	**Unconditioned Space**	**Indirectly Conditioned Space**	**Buried**
Heating- Only Ducts							
5	R-6	R-3.5	none	none	none	none	R-3.5
Cooling-Only Ducts							
5,6	R-3.5	R-1.9	R-3.5	R-1.9	R-1.9	none	none
Return Ducts							
1 to 8	R-3.5	R-3.5	R-3.5	none	none	none	none
Combine Heating and Cooling							
Supply Ducts							
5	R-6	R-6	R-6	R-1.9	R-3.5	none	R-3.5
Return Ducts							
1 to 8	R-3.5	R-3.5	R-3.5	none	none	none	none

3.14 OUTDOOR, FIELD APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Exterior piping, Exposed:

1. Aluminum jacket.

END OF SECTION

SECTION 22 1116

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Flexible connectors.
3. Escutcheons.
4. Sleeves and sleeve seals.
5. Wall penetration systems.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to 2012 IBC.

1.4 SUBMITTALS

A. Product Data: For the following products:

1. Specialty valves.
2. Transition fittings.
3. Dielectric fittings.
4. Escutcheons.
5. Sleeves and sleeve seals.

B. Water Samples: Specified in "Cleaning" Article.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61 for potable domestic water piping and components.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without Owner's written permission.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.3 PIPING JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 ESCUTCHEONS

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.

C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.

D. One Piece, Stamped Steel: Chrome-plated finish with setscrew or spring clips.

E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.

F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, setscrew or spring clips.

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

H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.5 SLEEVES

A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

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

C. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

D. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.

E. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

F. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.

G. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.6 SLEEVE SEALS

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

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex, Inc.
4. Pipeline Seal and Insulator, Inc.
5. Prior approved equal.

B. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.7 GROUT

A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105.

E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 and 23 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.

H. Install domestic water piping level without pitch and plumb.

I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

J. Install seismic restraints on piping. Comply with requirements in Division 22 and 23 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

L. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

N. Install piping adjacent to equipment and specialties to allow service and maintenance.

O. Install piping to permit valve servicing.

P. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

Q. Install piping free of sags and bends.

R. Install fittings for changes in direction and branch connections.

S. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

T. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.

U. Install thermometers on outlet piping from each water heater. Comply with requirements in Division 22 and 23 Section "Meters and Gages for Plumbing Piping" for thermometers.

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 and 23 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."

1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

3.5 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. NPS 1-1/2 and Smaller: Fitting-type coupling.
2. NPS 2 and Larger: Sleeve-type coupling.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 and 23 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Division 22 and 23 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 15 plumbing fixture Sections for connection sizes.

4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

B. Escutcheons for New Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
4. Bare Piping in Unfinished Service Spaces: One piece, stamped steel with set screw or spring clips.
5. Bare Piping in Equipment Rooms: One piece, stamped steel with set screw or spring clips.
6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

C. Escutcheons for Existing Piping:

1. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
2. Insulated Piping: Split plate, stamped steel with concealed or exposed-rivet hinge and spring clips.
3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
5. Bare Piping in Unfinished Service Spaces: Split plate, stamped steel with exposed-rivet hinge and set screw or spring clips.
6. Bare Piping in Equipment Rooms: Split plate, stamped steel with set screw or spring clips.
7. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

3.9 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.

B. Sleeves are not required for core-drilled holes.

C. Permanent sleeves are not required for holes formed by removable PE sleeves.

D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

E. Install sleeves in new partitions, slabs, and walls as they are built.

F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint.

G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint.

H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.

I. Seal space outside of sleeves in concrete slabs and walls with grout.

J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.

K. Install sleeve materials according to the following applications:

1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.

    a. Extend sleeves 2 inches above finished floor level.
    b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 7 Section "Sheet Metal Flashing and Trim" for flashing.

3. Sleeves for Piping Passing through Gypsum-Board Partitions:

    a. PVC pipe sleeves for pipes smaller than NPS 6.
    b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
    c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.

4. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe Insert type.
5. Sleeves for Piping Passing through Exterior Concrete Walls:

    a. Steel pipe sleeves for pipes smaller than NPS 6.
    b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
    c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
    d. Do not use sleeves when wall penetration systems are used.

6. Sleeves for Piping Passing through Interior Concrete Walls:

    a. Steel pipe sleeves for pipes smaller than NPS 6.
    b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestop materials and installations.

3.10 SLEEVE SEAL INSTALLATION

A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.

B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.11 WALL PENETRATION SYSTEM INSTALLATION

A. Install wall penetration systems in new, exterior concrete walls.

B. Assemble wall penetration system components with sleeve pipe. Install so that end of sleeve pipe and face of housing are flush with wall. Adjust locking devices to secure sleeve pipe in housing.

3.12 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 and 23 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.13 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

    a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.

4. Cap and subject piping to static water pressure of 100 psig, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.14 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.15 CLEANING

A. Clean and disinfect potable and non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.16 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and soldered joints.

D. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L; wrought- copper solder-joint fittings; and soldered joints.
2. Hard copper tube, ASTM B 88, Type L; grooved-joint copper-tube appurtenances; and grooved joints.

3.17 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION

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SECTION 22 1119

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Temperature-actuated water mixing valves.
5. Strainers.
6. Hose bibbs.
7. Wall hydrants.
8. Drain valves.
9. Water hammer arresters.
10. Air vents.
11. Trap-seal primer valves.
12. Trap-seal primer systems.

1.3 PERFORMANCE REQUIREMENTS

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

1.4 SUBMITTALS

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

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance:

1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

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

a. Ames Co.
b. Cash Acme.
c. Conbraco Industries, Inc.
d. FEBCO; SPX Valves & Controls.
e. Rain Bird Corporation.
f. Toro Company (The); Irrigation Div.
g. Watts Industries, Inc.; Water Products Div.
h. Zurn Plumbing Products Group; Wilkins Div.
i. Prior approved equal.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

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

a. Arrowhead Brass Products, Inc.
b. Cash Acme.
c. Conbraco Industries, Inc.
d. Legend Valve.
e. MIFAB, Inc.
f. Prier Products, Inc.
g. Watts Industries, Inc.; Water Products Div.
h. Woodford Manufacturing Company.
i. Zurn Plumbing Products Group; Light Commercial Operation.
j. Zurn Plumbing Products Group; Wilkins Div.
k. Prior approved equal.

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

2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

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

    a. Ames Co.
    b. Conbraco Industries, Inc.
    c. FEBCO; SPX Valves & Controls.
    d. Flomatic Corporation.
    e. Watts Industries, Inc.; Water Products Div.
    f. Zurn Plumbing Products Group; Wilkins Div.
    g. Prior approved equal.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller; steel with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Accessories:

    a. Valves: Ball type with threaded ends on inlet and outlet ofNPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
    b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Hose-Connection Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Conbraco Industries, Inc.
    b. Watts Industries, Inc.; Water Products Div.
    c. Woodford Manufacturing Company.
    d. Prior approved equal.

3. Standard: ASSE 1052.
4. Operation: Up to 10-foot head of water back pressure.
5. Inlet Size: NPS 1/2 or NPS 3/4.
6. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
7. Capacity: At least 3-gpm flow.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

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

a. Cash Acme.
b. Conbraco Industries, Inc.
c. Honeywell Water Controls.
d. Watts Industries, Inc.; Water Products Div.
e. Zurn Plumbing Products Group; Wilkins Div.
f. Prior approved equal.

2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.4 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing Valves:

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

a. Armstrong International, Inc.
b. Lawler Manufacturing Company, Inc.
c. Leonard Valve Company.
d. Powers; a Watts Industries Co.
e. Symmons Industries, Inc.
f. Or equal by.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig (860 kPa).
4. Type: Exposed-mounting, thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
9. Tempered-Water Setting: 110E F.
10. Tempered-Water Design Flow Rate: See drawings.
11. Pressure Drop at Design Flow Rate: See Drawings.
12. Valve Finish: Rough bronze.
13. Piping Finish: Copper.
14. Cabinet: Factory-fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.

B. Individual-Fixture, Water Tempering Valves:

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

a. Sloan.
b. Watts.
c. Prior approved equal.

2. Standard: ASSE 1016, thermostatically controlled water tempering valve.
3. Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.

4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.
8. Tempered-Water Setting: 110E F.
9. Tempered-Water Design Flow Rate:

2.5 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Drain: Factory-installed, hose-end drain valve.

2.6 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.7 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

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

    a. Josam Company.
    b. MIFAB, Inc.
    c. Prier Products, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.

g. Woodford Manufacturing Company.
h. Zurn Plumbing Products Group; Light Commercial Operation.
i. Zurn Plumbing Products Group; Specification Drainage Operation.
j. Or equal by.

2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig (860 kPa).
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.
9. Box and Cover Finish: Chrome plated.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): Two with each wall hydrant.

B. Vacuum Breaker Wall Hydrants:

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

a. Arrowhead Brass Products, Inc.
b. Mansfield Plumbing Products LLC.
c. McDonald, A. Y. Mfg. Co.
d. Prier Products, Inc.
e. Smith, Jay. R. Mfg. Co.; Division of Smith Industries, Inc.
f. Watts Industries, Inc.; Water Products Div.
g. Woodford Manufacturing Company.
h. Zurn Plumbing Products Group; Light Commercial Operation.
i. Or equal by.

2. Standard: ASSE 1019, Type A or Type B.
3. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
4. Classification: Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
5. Pressure Rating: 125 psig (860 kPa).
6. Operation: Loose key.
7. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
8. Inlet: NPS 1/2 or NPS 3/4 (DN 15 or DN 20).
9. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.8 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.

5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.9 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

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

    a. AMTROL, Inc.
    b. Josam Company.
    c. MIFAB, Inc.
    d. PPP Inc.
    e. Sioux Chief Manufacturing Company, Inc.
    f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    g. Tyler Pipe; Wade Div.
    h. Watts Drainage Products Inc.
    i. Zurn Plumbing Products Group; Specification Drainage Operation.
    j. Or equal by.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.10 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.11 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

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

    a. MIFAB, Inc.
    b. PPP Inc.
    c. Sioux Chief Manufacturing Company, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    e. Watts Industries, Inc.; Water Products Div.

f. Or equal by.

2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig (860 kPa) minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Valves:

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

a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
b. Or equal by.

2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 (DN 10) minimum, trap makeup connection.
3. Size: NPS 1-1/4 (DN 32) minimum.
4. Material: Chrome-plated, cast brass.

2.12 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

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

a. PPP Inc.
b. Or equal by.

2. Standard: ASSE 1044,
3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
4. Cabinet: Recessed-mounting steel box with stainless-steel cover.
5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
6. Vacuum Breaker: ASSE 1001.
7. Number Outlets: See drawings.
8. Size Outlets: NPS 1/2.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 and 23 Section "Common work results" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted. Install on hot water recirculating lines where they connect to hot water lines.

E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers.
2. Install cabinet-type units recessed in or surface mounted on wall as specified.

F. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve.

G. Install water hammer arresters in water piping according to PDI-WH 201.

H. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

I. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

J. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

K. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 and 23 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding."

C. Connect wiring according to Division 26 Section "Conductors and Cables."

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Reduced-pressure-principle backflow preventers.
3. Water pressure-reducing valves.
4. Calibrated balancing valves.

5. Primary, thermostatic, water mixing valves.
6. Supply-type, trap-seal primer valves.
7. Trap-seal primer systems.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

SECTION 22 1316

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

B. Related Sections:

1. Division 2 Section "Sanitary Sewerage" for sanitary sewerage piping and structures outside the building.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.4 SUBMITTALS

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

B. LEED Submittal:

1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.

C. Shop Drawings: For sovent drainage system. Include plans, elevations, sections, and details.

D. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than 72 hours in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service and Extra Heavy class(es).

B. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.

C. CISPI, Hubless-Piping Couplings:

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

a. ANACO-Husky.
b. Fernco Inc.
c. MIFAB, Inc.

d. Tyler Pipe.
e. Prior approved equal.

2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Heavy-Duty, Hubless-Piping Couplings:

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

a. ANACO-Husky.
b. MIFAB, Inc.
c. Tyler Pipe.
d. Prior approved equal.

2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 ABS PIPE AND FITTINGS

A. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.

B. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.

C. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

D. Solvent Cement: ASTM D 2235.

1. Use ABS solvent cement that has a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F 656.

1. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Solvent Cement: ASTM D 2564.

1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:

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

        1) Dallas Specialty & Mfg. Co.
        2) Fernco Inc.
        3) Mission Rubber Company; a division of MCP Industries, Inc.
        4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
        5) Prior approved equal.

    b. Standard: ASTM C 1173.
    c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
    d. Sleeve Materials:

        1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
        2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
        3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

4. Shielded, Nonpressure Transition Couplings:

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

        1) Cascade Waterworks Mfg. Co.
        2) Mission Rubber Company; a division of MCP Industries, Inc.
        3) Prior approved equal.

    b. Standard: ASTM C 1460.
    c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
5. Pressure Transition Couplings:
    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

        1) Cascade Waterworks Mfg. Co.
        2) Dresser, Inc.
        3) EBAA Iron, Inc.
        4) JCM Industries, Inc.
        5) Romac Industries, Inc.
        6) Smith-Blair, Inc; a Sensus company.
        7) The Ford Meter Box Company, Inc.

8) Viking Johnson.
9) Prior approved equal.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Division 2 Section "Earthwork."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 22 and 23 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants,

cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

M. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

O. Install aboveground ABS piping according to ASTM D 2661.

P. Install aboveground PVC piping according to ASTM D 2665.

Q. Install underground ABS and PVC piping according to ASTM D 2321.

R. Install engineered soil and waste drainage and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Sovent Drainage System: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

S. Plumbing Specialties:

1. Install backwater valves in sanitary waste gravity-flow piping. Comply with requirements for backwater valves specified in Division 22 and 23 Section "Sanitary Waste Piping Specialties."
2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Division 22 and 23 Section "Sanitary Waste Piping Specialties."
3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Division 22 and 23 Section "Sanitary Waste Piping Specialties."

T. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 and 23 Section "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 and 23 Section "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 and 23 Section "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.

C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

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

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Shielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:

    a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
    b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 and 23 Section "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.
2. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
3. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves.
2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Comply with requirements for backwater valve specified in Division 22 and 23 Section "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Division 22 and 23 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 and 23 Section "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting[**, valve,**] and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.

3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
5. NPS 10 and NPS 12 (DN 250 and DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
6. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).

G. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

H. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 and NPS 8 (DN 150 and DN 200): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
5. NPS 10 and NPS 12 (DN 250 and DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

I. Install supports for vertical ABS and PVC piping every 48 inches (1200 mm).

J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Comply with requirements for backwater valves cleanouts and drains specified in Division 22 and 23 Section "Sanitary Waste Piping Specialties."
6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 22 and 23 Section "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.11 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste and vent piping shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
4. Soild-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Underground, soil, waste, and vent piping shall be any of the following:

1. Extra Heavy class, cast-iron soil piping; calking materials; and calked joints.
2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
3. Solid wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
4. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION

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SECTION 22 1319
SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Air-admittance valves.
4. Trap Guards.
5. Roof flashing assemblies.
6. Miscellaneous sanitary drainage piping specialties.
7. Flashing materials.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene plastic.

D. PE: Polyethylene plastic.

E. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer, rated capacities, operating characteristics, and accessories for the following:

1. Cleanouts.
2. Floor drains.
3. Air admittance valves.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

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

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
    g. Prior approved equal.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

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

    a. Commercial Enameling Co.
    b. Josam Company; Josam Div.
    c. MIFAB, Inc.
    d. Prier Products, Inc.
    e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    f. Tyler Pipe; Wade Div.
    g. Watts Drainage Products Inc.
    h. Zurn Plumbing Products Group; Light Commercial Operation.
    i. Zurn Plumbing Products Group; Specification Drainage Operation.

j. Prior approved equal.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Clamping Device: Required.
6. Outlet: Bottom.
7. Top or Strainer Material: Stainless steel.
8. Top Shape: Round.
9. Top Loading Classification: Medium Duty.
10. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
11. Trap Pattern: Deep-seal P-trap.
12. Trap Features: Trap-seal primer valve drain connection.

2.3 AIR-ADMITTANCE VALVES

A. Wall Box:

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

a. Durgo, Inc.
b. Oatey.
c. RectorSeal.
d. Studor, Inc.
e. Prior approved equal.

2. Description: White plastic housing with white plastic grille, made for recessed installation. Include bottom pipe connection and space to contain one air-admittance valve.
3. Size: About 9 inches wide by 8 inches high by 4 inches deep.

2.4 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Acorn Engineering Company; Elmdor/Stoneman Div.
b. Thaler Metal Industries Ltd.
c. Prior approved equal.

B. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

1. Open-Top Vent Cap: Without cap.
2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

    a. NPS 2: 4-inch- minimum water seal.
    b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

B. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

C. Trap Guard

1. Description: Trap guard shall have flexible elastomeric material open on top, with curl closure on bottom as needed to allow water to flow, but not allow sewer gases to escape.
2. Trap guards by Proset or prior approved equal.

2.6 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft. thickness.
2. Vent Pipe Flashing: 8 oz./sq. ft. thickness.

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 and 23 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.

G. Install air-admittance-valve wall boxes recessed in wall where indicated on drawings.

H. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

I. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

J. Install deep-seal traps on all floor drains.

A. Install trap guards at floor drains that require trap-seal.
1. Size: Same as floor drain inlet.

B. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

C. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

D. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 7 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

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SECTION 22 1413

FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following storm drainage piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. LLDPE: Linear, low-density polyethylene plastic.

C. PE: Polyethylene plastic.

D. PVC: Polyvinyl chloride plastic.

E. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:

1. Storm Drainage Piping: 30-foot head of water.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Shop Drawings:

1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.

2. Controlled-Flow Storm Drainage System: Include calculations, plans, and details.

C. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy class(es).

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

a. Available Manufacturers:

1) ANACO.
2) Fernco, Inc.
3) Ideal Div.; Stant Corp.
4) Mission Rubber Co.
5) Tyler Pipe; Soil Pipe Div.
6) Or equal.

2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

a. Manufacturers:

1) ANACO.
2) Clamp-All Corp.
3) Ideal Div.; Stant Corp.
4) Mission Rubber Co.
5) Tyler Pipe; Soil Pipe Div.
6) Or equal.

3. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.

a. Manufacturers:

1) MG Piping Products Co.
2) Or equal.

C. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. ANACO.
1) Or equal.

2.5 ABS PIPE AND FITTINGS

A. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.

B. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.

C. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

2.6 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Cellular-Core, Sewer and Drain Series, PVC Pipe: ASTM F 891, Series PS 100.

1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Series PS 100 sewer and drain pipe.

2.7 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Dallas Specialty & Mfg. Co.
b. Fernco, Inc.
c. Logan Clay Products Company (The).
d. Mission Rubber Co.
e. NDS, Inc.
f. Plastic Oddities, Inc.
g. Or equal.

2. Sleeve Materials:

a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Mission Rubber Co.
c. Or equal.

C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. ANACO.
b. Or equal.

D. Flexible Ball Joints: Ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include gasketed ball-joint section and ductile-iron gland, rubber gasket, and steel bolts.

1. Manufacturers:

    a. EBAA Iron Sales, Inc.
    b. Or equal.

E. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers:

    a. EBAA Iron Sales, Inc.
    b. Romac Industries, Inc.
    c. Star Pipe Products; Star Fittings Div.
    d. Or equal.

F. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers:

    a. SIGMA Corp.
    b. Or equal.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Plastic piping shall not be allowed in ceiling return plenums. Where piping is exposed to ceiling plenums, cast iron shall be used.

C. Aboveground storm drainage piping NPS 6 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; standard, and heavy-duty shielded, stainless-steel couplings; and coupled joints.
3. ABS pipe, ABS socket fittings, and solvent-cemented joints.
4. PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.3 PIPING INSTALLATION

A. Storm sewer and drainage piping outside the building are specified in Division 2 Section "Storm Drainage."

B. Basic piping installation requirements are specified in Division 22 and 23 Section "Common Work Results."

C. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 and 23 Section "Mechanical Vibration and Seismic Controls."

D. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Plumbing Specialties."

E. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.

F. Install underground, steel, force-main piping.[Install encasement on piping according to ASTM A 674 or AWWA C105.]

G. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 and 23 Section "Common Work Results."

H. Install wall-penetration fitting system at each service pipe penetration through foundation wall. Make installation watertight.

I. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

   1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

J. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

L. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:

   1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
   2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

M. Install engineered controlled-flow storm drainage piping in locations indicated.

N. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

O. Install ABS storm drainage piping according to ASTM D 2661.

P. Install PVC storm drainage piping according to ASTM D 2665.

Q. Install underground ABS and PVC storm drainage piping according to ASTM D 2321.

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 and 23 Section "Basic Mechanical Materials and Methods."

B. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

C. Hub-and-Spigot, Cast-Iron Soil Piping Calked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

D. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

E. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 and 23 Section "Valves."

B. Shutoff Valves: Install shutoff valve on each sump pump discharge.

1. Install gate or full-port ball valve for piping NPS 2 and smaller.
2. Install gate valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sump pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
2. Install backwater valves in accessible locations.
3. Backwater valve are specified in Division 22 Section "Plumbing Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 22 and 23 Section "Mechanical Vibration Controls and Seismic Restraints."

B. Pipe hangers and supports are specified in Division 22 and 23 Section "Hangers and Supports." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install supports according to Division 22 and 23 Section "Hangers and Supports."

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6: 60 inches with 3/4-inch rod.
5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6: 48 inches with 3/4-inch rod.
5. NPS 8 to NPS 12: 48 inches with 7/8-inch rod.

I. Install supports for vertical ABS and PVC piping every 48 inches.

J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

D. Connect force-main piping to the following:

1. Storm Sewer: To exterior force main or storm manhole.
2. Sump Pumps: To sump pump discharge.

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 20-foot head of water. From 4 hours before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

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SECTION 22 1423

STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following storm drainage piping specialties:

1. Cleanouts.
2. Through-penetration firestop assemblies.
3. Roof drains.
4. Miscellaneous storm drainage piping specialties.
5. Flashing materials.

B. Related Sections include the following:

1. Division 22 Section "Sanitary Waste Piping Specialties" for backwater valves, floor drains, trench drains and channel drainage systems connected to sanitary sewer, air admittance valves, FOG disposal systems, grease interceptors and removal devices, oil interceptors, and solid interceptors.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PUR: Polyurethane plastic.

H. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.6 COORDINATION

A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

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

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
    g. Prior approved equal.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts:

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

    a. Josam Company; Josam Div.
    b. Oatey.
    c. Sioux Chief Manufacturing Company, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Zurn Plumbing Products Group; Light Commercial Operation.
    h. Mifab.
    i. Prior approved equal.

2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.

6. Clamping Device: Required.
7. Outlet Connection: Threaded.
8. Closure: Cast-iron plug.
9. Adjustable Housing Material: Cast iron with.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Medium Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.
g. Prior approved equal.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

D. Plastic Floor Cleanouts:

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

a. Canplas LLC.
b. IPS Corporation.
c. NDS Inc.
d. Plastic Oddities; a division of Diverse Corporate Technologies.
e. Sioux Chief Manufacturing Company, Inc.
f. Zurn Plumbing Products Group; Light Commercial Operation.
g. Prior approved equal.

2. Size: Same as connected branch.
3. Body: PVC.
4. Closure Plug: PVC.
5. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Expansion Joints:

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected piping.

B. Downspout Boots:

1. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 outlet; and shop-applied bituminous coating.
2. Size: Inlet size to match downspout.
3. Description: ASTM A 74, Service class, hub-and-spigot, cast-iron soil pipe.
4. Size: Same as or larger than connected downspout.

C. Conductor Nozzles:

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

D. Downspout Nozzle:

1. All nickel bronze body with decorative face of wall flange and outlet nozzle.
2. Approved Types -

a. Zurn Z-199 or equal by
b. Wade
c. Smith
d. Josam

2.3 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft. thickness.

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 7.

1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Position roof drains for easy access and maintenance.

F. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

G. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

H. Install manufactured, gray-iron downspout boots at grade with top 18 inches above grade. Secure to building wall.

I. Install cast-iron soil pipe downspout boots at grade with top of hub 18 inches above grade.

J. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

K. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 4000

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following conventional plumbing fixtures and related components:

1. Lavatories.
2. Lavatory Faucets.
3. Water closets.
4. Toilet seats.
5. Flushometers - Water Closets.
6. Urinals.
7. Flushometers - Urinals.
8. Fixture supports.
9. Protective shielding guards.
10. Service sinks.
11. Drains.
12. Shower Faucets.

B. Related Sections include the following:

1. Division 22 Section "Plumbing Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

F. FRP: Fiberglass-reinforced plastic.

G. PMMA: Polymethyl methacrylate (acrylic) plastic.

H. PVC: Polyvinyl chloride plastic.

I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Operation and Maintenance Data: For plumbing fixtures to include in operation, and maintenance manuals.

C. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
2. Plastic Shower Enclosures: ANSI Z124.2.
3. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
4. Slip-Resistant Bathing Surfaces: ASTM F 462.
5. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
6. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.

7. Vitreous-China Fixtures: ASME A112.19.2M.
8. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
9. Water-Closet, Flushometer Tank Trim: ASSE 1037.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
4. Faucets: ASME A112.18.1.
5. Hose-Connection Vacuum Breakers: ASSE 1011.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
8. NSF Potable-Water Materials: NSF 61.
9. Pipe Threads: ASME B1.20.1.
10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
11. Supply Fittings: ASME A112.18.1.
12. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for shower faucets:

1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
3. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
4. Faucets: ASME A112.18.1.
5. Hand-Held Showers: ASSE 1014.
6. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
7. Hose-Coupling Threads: ASME B1.20.7.
8. Manual-Control Antiscald Faucets: ASTM F 444.
9. Pipe Threads: ASME B1.20.1.
10. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
11. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
12. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Manual-Operation Flushometers: ASSE 1037.
4. Plastic Tubular Fittings: ASTM F 409.
5. Brass Waste Fittings: ASME A112.18.2.
6. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

K. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Disposers: ASSE 1008 and UL 430.
2. Flexible Water Connectors: ASME A112.18.6.
3. Floor Drains: ASME A112.6.3.
4. Grab Bars: ASTM F 446.
5. Hose-Coupling Threads: ASME B1.20.7.
6. Hot-Water Dispensers: ASSE 1023 and UL 499.

7. Off-Floor Fixture Supports: ASME A112.6.1M.
8. Pipe Threads: ASME B1.20.1.
9. Plastic Shower Receptors: ANSI Z124.2.
10. Plastic Toilet Seats: ANSI Z124.5.
11. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures of unit shell.
   b. Faulty operation of controls, blowers, pumps, heaters, and timers.
   c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period: One year from date of Substantial Completion.

1.7 EXTRA MATERIALS

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

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 2 of each type.
4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.

PART 2 - PRODUCTS

2.1 LAVATORIES

A. Lavatories:

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

   a. American Standard Companies, Inc.
   b. Commercial Enameling Company.
   c. Eljer.
   d. Kohler Co.
   e. Crane.
   f. Sloan
   g. Zurn.

2. Description: Accessible, wall-mounting, vitreous-china fixture.

a. Type: With back.
b. Size: 20 by 18 inches rectangular.
c. Faucet Hole Punching: Three holes, 4-inch centers.
d. Color: White.
e. Supplies: NPS 3/8 chrome-plated copper with stops.
f. Drain: Grid with offset waste.

1) Location: Near back of bowl.

B. Lavatories, Counter Mounted:

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

a. Commercial Enameling Company.
b. Eljer.
c. Kohler Co.
d. American Standard.
e. Crane.
f. Zurn.
g. Prior approved equal.

2. Description: Accessible Counter-mounting, vitreous-china fixture.

a. Type: Self-rimming.
b. Oval Lavatory Size: 20 by 17 inches.
c. Faucet Hole Punching: Three holes, 4-inch centers.
d. Color: White.
e. Supplies: NPS 3/8 chrome-plated copper with stops.
f. Drain: Grid with offset waste.

1) Location: Near back of bowl.

C. Mixing valve:

1. Valve shall be thermostatic and pressure mixing valve with maximum 5 degree approach temperature.
2. Approved Manufacturers -

a. Powers hydroguard TP or equal by
b. Sloan
c. Prior approved equal

2.2 LAVATORY FAUCETS

A. Lavatory Faucets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Delta Faucet Company. 3549LF or equal by:

b. American Standard Companies, Inc.

c. Bradley Corporation.
d. Chicago Faucets.
e. Eljer.
f. Elkay Manufacturing Co.
g. Fisher Manufacturing Co.
h. Just Manufacturing Company.
i. Kohler Co.
j. Moen, Inc.
k. Royal Brass Mfg. Co.
l. Sayco; a Briggs Plumbing Products, Inc. Company.
m. Sloan
n. Speakman Company.
o. T & S Brass and Bronze Works, Inc.
p. Zurn Plumbing Products Group; Commercial Brass Operation.
q. Prior approved equal.

2. Description: Two-handle mixing valve. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

a. Body Material: Commercial, solid brass.
b. Finish: Polished chrome plate.
c. Maximum Flow Rate: 1.2 gpm.
d. Centers: 4 inches.
e. Mounting: Deck, concealed.
f. Spout: Rigid type.
g. Spout Outlet: Aerator.
h. Drain: Grid.
i. Tempering Device: Thermostatic.

2.3 WATER CLOSETS

A. Water Closets, Wall Mounted Flush Valve:

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

a. Kohler Co. K-4330-ET or equal by
1) Zurn.
2) American Standard Companies, Inc. AFT Wall Water Saver 2257.103.
3) Crane Plumbing, L.L.C./Fiat Products.
4) Eljer.
5) Sloan
6) Prior approved equal.

2. Description Accessible, Where indicated on drawings, wall Wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.
a. Style: Flushometer valve.

1) Bowl Type: Elongated with siphon-jet design.
2) Design Consumption: 1.6 gal./flush.
3) Color: White.

b. Flushometer.

2.4 TOILET SEATS

A. Toilet Seats:

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

    a. Comfort seats or equal C108SSCAM.
    b. American Standard Companies, Inc.
    c. Bemis Manufacturing Company.
    d. Church Seats.
    e. Eljer.
    f. Kohler Co.
    g. Olsonite Corp.

2. Description: Toilet seat for water-closet-type fixture.

    a. Material: Molded, heavy duty, solid, anti-microbial plastic, with fire retardant.
    b. Configuration: Open front without cover.
    c. Hinge Type: Stainless Steel, self-sustaining.
    d. Class: Standard commercial.
    e. Color: White.

2.5 FLUSHOMETERS-WATER CLOSETS

A. Flushometers, Water Closets:

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

    a. Coyne & Delany Co.
    b. Sloan Valve Company.
    c. Zurn Plumbing Products Group.
    d. T.C.

2. Description: Flushometer for water closet fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.

    a. Internal Design: Diaphragm operation.
    b. Style: Exposed.
    c. Inlet Size: NPS 1”.
    d. Trip Mechanism: Battery-operated sensor actuator.
    e. Consumption: 1.6 gal./flush.

2.6 URINALS

A. Urinals:

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

    a. American Standard Companies, Inc.

b. Briggs Plumbing Products, Inc.
c. Crane Plumbing, L.L.C./Fiat Products.
d. Eljer.
e. Kohler Co.
f. Dexter K 5016-T
g. TOTO USA, Inc.
h. Sloan
i. Zurn.
j. T.C.
k. Prior approved equal.

2. Description: Accessible, where indicated on drawings, Wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.

a. Type: Blowout with extended shields.
b. Strainer or Trapway: Open trapway with integral trap.
c. Design Consumption: 1 gal./flush.
d. Color: White.
e. Supply Spud Size: NPS 3/4.
f. Outlet Size: NPS 1-1/2.

2.7 FLUSHOMETERS-URINALS

A. Flushometers, Urinals:

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

a. Coyne & Delany Co.
b. Sloan Valve Company.
c. Zurn Plumbing Products Group.
d. T.C.

2. Description: Flushometer for urinal-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.

a. Internal Design: Diaphragm operation.
b. Style: Exposed.
c. Inlet Size: NPS 3/4.
d. Trip Mechanism: Battery-operated sensor actuator.
e. Consumption: 1.0 gal./flush.

2.8 FIXTURE SUPPORTS

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

1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.

5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.
7. Prior approved equal.

B. Water-Closet Supports:

1. Description: Combination carrier designed for accessible or standard mounting height as required of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

C. Urinal Supports:

1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

D. Lavatory Supports:

1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

E. Sink Supports:

1. Description: Type II, sink carrier with hanger plate, bearing studs, and tie rod for sink-type fixture. Include steel uprights with feet.

2.9 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Piping Enclosures:

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

a. TRUEBRO, Inc.
b. Plumberex.
c. McGuire.
d. Proflo.
e. Prior approved equal.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.10 SERVICE SINKS

A. Service Sinks:

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

    a. American Standard Companies, Inc.
    b. Commercial Enameling Company.
    c. Eljer.
    d. Kohler Co.

2. Description: Floor-mounting, enameled, cast-iron fixture with front apron, raised back, and coated, wire rim guard.

    a. Size: 28 by 28 inches.
    b. Color: White.
    c. Faucet: Sink American Standard 8344.111 with threaded spout and48 inch hose and damp or equal by

        1) Eljer.
        2) Kohler.
        3) Speakman.

    d. Drain: Grid with NPS 2 outlet.

2.11 DRAINS

A. Drains:

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

    a. Blucher USA.
    b. Prior approved equal.

B. Sanitary Floor Drain, BFD-320

1. Size: 4 inches**.**
2. Compliance:

    a. ASME A112.3.1.
    b. UPC

3. Drain Body:

    a. Material: Type 304, stainless steel.
    b. Outlet: Bottom outlet.

4. Grate:

    a. Material: Type 304, stainless steel.
    b. Diameter: 8”x 8” square grate.
    c. Thickness: 1/8”.

C. Sanitary Floor Drain, BFD-340

1. Size: 4 inches

2. Compliance:

    a. ASME A112.3.1.
    b. UPC.

3. Drain Body:

    a. Material: Type 304, stainless steel.
    b. Outlet: Bottom outlet.

4. Grate:

    a. Material: Type 304, stainless steel.
    b. Diameter: 12” x 12” square grate.
    c. Thickness: 1/8”.

D. Waterline Shower Channel with Sheet Membrane Clamp:

1. Outlet size: [2 inches] [indicated on the drawings].
2. Compliance:

    a. ASME A112.3.1.
    b. UPC.

3. Drain Body:

    a. Material: Type 304, stainless steel.
    b. Outlet: Bottom outlet.
    c. Seal: Dual O-ring seals.

4. Grate:

    a. Material: Type 304, stainless steel.
    b. Dimension: [3-1/4” x 26”] [3-1/4”x 30”] [3-1/4” x 36”] [3-1/4” x 42”] [3-1/4” x 48”] [3-1/4” x 60”] [3-1/4” x 72”] [indicated on the drawings}
    c. Shape: Rectangular.

2.12 SHOWER FAUCETS

A. Shower Faucets:

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

    a. American Standard Companies, Inc.
    b. Chicago Faucets.
    c. Delta Faucet Company.
    d. Eljer.
    e. Kohler Co.
    f. Leonard Valve Company.
    g. Moen, Inc.
    h. Powers; a Watts Industries Co.
    i. Price Pfister, Inc.
    j. Sayco; a Briggs Plumbing Products, Inc. Company.

k. Speakman Company.
l. Symmons Industries, Inc.
m. T & S Brass and Bronze Works, Inc.
n. Zurn Plumbing Products Group.

2. Description: Single-handle pressure-balance valve. Include hot- and cold-water indicators; check stops; and shower head, arm, and flange. Coordinate faucet inlets with supplies and outlet with diverter valve.

a. Body Material: Solid brass.
b. Finish: Polished chrome plate.
c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
d. Diverter Valve: Integral with mixing valve.
e. Mounting: Exposed.
f. Antiscald Device: Integral with mixing valve.
g. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
h. Shower Head Type: Ball joint and Hand held, hook mounted.
i. Shower Head Material: Metallic with chrome-plated finish.
j. Spray Pattern: Adjustable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

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

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.

G. Install counter-mounting fixtures in and attached to casework.

H. Install fixtures level and plumb according to roughing-in drawings.

I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 23 Section "Valves."

J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

M. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

N. Install toilet seats on water closets.

O. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

P. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

Q. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

R. Install shower flow-control fittings with specified maximum flow rates in shower arms.

S. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

T. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

U. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 and 23 Section "Basic Mechanical Materials and Methods."

V. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 7 Section "Joint Sealants."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding."

D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust all fixtures. Replace damaged and malfunctioning units and controls.

C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

D. Replace washers and seals of leaking and dripping faucets and stops.

E. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

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SECTION 22 4700

DRINKING FOUNTAINS AND WATER COOLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following drinking fountains and related components:

1. Drinking fountains.
2. Fixture supports.

1.3 DEFINITIONS

A. Accessible Drinking Fountain: Fixture that can be approached and used by people with disabilities.

B. Cast Polymer: Dense, cast-filled-polymer plastic.

C. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.

D. Fitting: Device that controls flow of water into or out of fixture.

E. Fixture: Drinking fountain or water cooler unless one is specifically indicated.

F. Remote Water Cooler: Electrically powered equipment for generating cooled drinking water.

G. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.4 SUBMITTALS

A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For fixtures to include in operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for fixtures for people with disabilities.

C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

D. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.

E. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

1.6 EXTRA MATERIALS

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

1. Filter Cartridges: Provide 2 extra cartriges.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

A. Drinking Fountains, DF-1.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

    a. Elkay Manufacturing company: EZWS-EDFP217K or approved equal by:

    b. Filtrine Manufacturing Company; Drinking Water Division.
    c. Halsey Taylor.
    d. Haws Corporation.
    e. Oasis Corporation.
    f. Stern-Williams Co., Inc.

g. Prior approved equal.

4. Description: Accessible. Stainless steel, recessed:

a. Receptor(s):

1) Number: Two.
2) Material: Chrome-plated brass or stainless steel.
3) Shape: Rectangular with soft edges.
4) Bubbler: One for each receptor, with adjustable stream regulator, located on deck.
5) Bottle Filler: Yes.

b. Controls: Push button with adjustable stream regulator.
c. Access to Internal Components: Panel in pedestal.
d. Supply: NPS 3/8 with ball, gate, or globe valve.
e. Drain: Grid with NPS 1-1/4 minimum waste to drainage system.

2.2 FIXTURE SUPPORTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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

1. Josam Co.
2. MIFAB Manufacturing, Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.
7. Prior approved equal.

C. Description: ASME A112.6.1M, carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.

1. Type I: Hanger-type carrier with two vertical uprights.
2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.

B. Examine walls and floors for suitable conditions where fixtures are to be installed.

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

3.2 APPLICATIONS

A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.

B. Use mounting frames for recessed water coolers, unless otherwise indicated.

C. Set freestanding and pedestal drinking fountains on floor.

D. Set remote water coolers on floor, unless otherwise indicated.

E. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.

B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.

C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.

D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 and 23 Section "Valves."

E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 and 23 Section "Basic Mechanical Materials and Methods."

G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 7 Section "Joint Sealants."

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding."

D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.5 FIELD QUALITY CONTROL

A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.

1. Remove and replace malfunctioning units and retest as specified above.
2. Report test results in writing.

3.6 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust water cooler temperature settings.

3.7 CLEANING

A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION

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DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

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SECTION 23 0100

GENERAL REQUIREMENTS FOR PLUMBING AND HVAC

PART 1 - GENERAL

1.1 GENERAL

A. General Conditions and Division 01 apply to this Division.

B. See Section 220100, “General Requirements for Plumbing and HVAC.”

1.2 SCOPE

A. All requirements and information contained in Division 22 Section 220100, “General Requirements for Plumbing and HVAC” shall apply to both Divisions 22 and 23.

1.3 SITE OBSERVATION

A. The Contractor shall examine the site and understand the conditions which may affect the performance of work of this Division before submitting proposals for this work.

B. No subsequent allowance for time or money will be considered for any consequence related to failure to examine existing site conditions.

1.4 DRAWINGS

A. See Section 220100, “General Requirements for Plumbing and HVAC.”

1.5 COORDINATION OF WORK:

A. See Section 220100, “General Requirements for Plumbing and HVAC.”

1.6 EQUIPMENT & MATERIALS:

A. See Section 220100, “General Requirements for Plumbing and HVAC.”

1.7 PROJECT SUBMITTALS:

A. See Section 220100, “General Requirements for Plumbing and HVAC.”

1.8 WARRANTY GUARANTEE:

A. See Section 220100, “General Requirements for Plumbing and HVAC.”

B. The Contractor shall warrant all materials and equipment to be of quality consistent with specifications as represented by manufacturer's published data.

C. The Contractor shall guarantee that the installation and operation of the equipment shall be free from defects for a period of one year beginning at date of substantial completion and acceptance. The Contractor shall replace or repair any part of the installation that is found to be defective or incomplete within the guarantee period.

D. The one year guarantee on equipment and systems shall commence when equipment has been demonstrated to work and has been accepted. (Example: If an equipment item fails to perform and it takes 9 months after substantial completion to correct, then the guarantee shall commence after the item has been demonstrated to perform and has been accepted.)

E. Substantial completion and acceptance in no way relieves the Contractor from providing the systems and equipment as specified.

1.9 OPERATION AND MAINTENANCE MANUAL FOR MECHANICAL SYSTEMS

A. See Section 220100, “General Requirements for Plumbing and HVAC.”

.

PART 2 - PRODUCTS
(Not Used)

PART 3 - EXECUTION
(Not Used)

END OF SECTION 230100

SECTION 23 0500

BASIC PLUMBING AND HVAC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Division 22, Section 220500, “Basic Plumbing and HVAC Materials and Methods.”

1.2 SUMMARY

A. All requirements in Division 22, Section 220500, “Basic Plumbing and HVAC Materials and Methods” shall apply to both Divisions 22 and 23.

1. Equipment installation requirements common to equipment sections.

PART 2 - PRODUCTS

2.1 See Division 22, Section 220500, “Basic Plumbing and HVAC Materials and Methods.”

PART 3 - EXECUTION

3.1 See Division 22, Section 220500, “Basic Plumbing and HVAC Materials and Methods”

END OF SECTION 230500

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SECTION 23 0553

IDENTIFICATION FOR MECHANICAL AND PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

RELATED DOCUMENTS

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

B. Section 22 “Identification for Mechanical and Plumbing Piping and Equipment”

SUMMARY

C. Section 22 ““Identification for Mechanical and Plumbing Piping and Equipment” shall apply to both divisions 22 and 23.

PART 2 - PRODUCTS

SEE SECTION 22 “Identification for Mechanical and Plumbing Piping and Equipment”

PART 3 - EXECUTION

SEE SECTION 22 “Identification for Mechanical and Plumbing Piping and Equipment”

END OF SECTION 230553

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SECTION 23 0593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes TAB to produce design objectives for the following:

1. Air Systems:

    a. Constant-volume air systems.
    b. Variable-air-volume systems.

2. HVAC equipment quantitative-performance settings.
3. Existing systems TAB.
4. Verifying that automatic control devices are functioning properly.
5. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

E. NC: Noise criteria.

F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

G. RC: Room criteria.

H. Report Forms: Test data sheets for recording test data in logical order.

I. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

J. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

K. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

L. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

M. TAB: Testing, adjusting, and balancing.

N. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

O. Test: A procedure to determine quantitative performance of systems or equipment.

P. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

A. Qualification Data: Within 15 days from Contractor's Notice to Proceed, submit 4 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 60 days from Contractor's Notice to Proceed, submit 4 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.

D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

E. Sample Report Forms: Submit two sets of sample TAB report forms.

F. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by AABC or NEBB.

B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:

a. Submittal distribution requirements.
b. The Contract Documents examination report.
c. TAB plan.
d. Work schedule and Project-site access requirements.
e. Coordination and cooperation of trades and subcontractors.
f. Coordination of documentation and communication flow.

C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

E. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.

1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

G. Approved TAB agencies:

1. Bonneville Test and Balance.
2. BTC Services.
3. Certified Test and Balance.
4. Intermountain Test and Balance.
5. Mechanical Testing Corporation
6. RS Analysis.
7. Tempco
8. Testing and Balancing, Inc.

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS

(Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine Project Record Documents described in Division 1 Section "Project Record Documents."

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

G. Examine system and equipment test reports.

H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

M. Examine strainers for clean screens and proper perforations.

N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

P. Examine system pumps to ensure absence of entrained air in the suction piping.

Q. Examine equipment for installation and for properly operating safety interlocks and controls.

R. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices are operated by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.

6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at indicated values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to indicated values.

S. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

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

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling unit components.

L. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure fan static pressures to determine actual static pressure as follows:

    a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
    b. Measure static pressure directly at the fan outlet or through the flexible connection.
    c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
    d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

    a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling,

full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.

5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record the final fan performance data.

3.7 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.8 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.9 PROCEDURES FOR HEAT-TRANSFER COILS

A. Water Coils: Measure the following data for each coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Refrigerant Coils: Measure the following data for each coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.10 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.11 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the operation of the drain pan and condensate drain trap.
7. Check bearings and other lubricated parts for proper lubrication.
8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished.

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan, speed, filter, and coil face velocity.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.

3. If calculations increase or decrease the airflow and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated airflow and water flow rates. If 5 percent or less, equipment adjustments are not required.
4. Air balance each air outlet.

3.12 PROCEDURES FOR TESTING DUCT SYSTEMS

A. Perform duct leakage tests and duct cleanliness tests.

B. Duct system will be considered defective if it does not pass initial tests and inspections. The sheet metal contractor shall be responsible to make corrections and repairs as necessary to pass the tests. TAB contractor shall include initial test and 1 follow up test. Any additional follow up tests required due to system not passing shall be performed by the TAB contractor at the Division 22 and 23 contractor's expense.

3.13 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Check free travel and proper operation of control devices such as damper and valve operators.

F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.

G. Check the interaction of electrically operated switch transducers.

H. Check the interaction of interlock and lockout systems.

I. Check main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.14 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
2. Air Outlets and Inlets: 0 to minus 10 percent.
3. Heating-Water Flow Rate: 0 to minus 10 percent.
4. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.15 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.16 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of instruments used for procedures, along with proof of calibration.

C. Provide final report on standard AABC or NEBB forms.

3.17 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
2. Randomly check the following for each system:

    a. Measure airflow of at least 10 percent of air outlets.
    b. Measure water flow of at least 5 percent of terminals.
    c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
    d. Measure sound levels at two locations.
    e. Measure space pressure of at least 10 percent of locations.
    f. Verify that balancing devices are marked with final balance position.
    g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total

measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.

4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.18 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

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SECTION 23 0700

HVAC AND PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. See section 220700 for HVAC and plumbing insulation.

1.2 SUMMARY

A. Section 220700 HVAC and Plumbing insulation shall apply to insulation requirements for both division 22 and 23.

B. Division 23 Section 233113 "Metal Ducts" for duct liners.

1.3 SUBMITTALS

A. See section 220700.

PART 2 - PRODUCTS

2.1 See section 220700.

PART 3 - EXECUTION

3.1 See section 220700

END OF SECTION 230700

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SECTION 23 3113

METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Double-wall round and flat-oval ducts and fittings.
4. Sheet metal materials.
5. Duct liner.
6. Sealants and gaskets.
7. Hangers and supports.
8. Seismic-restraint devices.

B. Related Sections:

1. Division 22 and 23 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
2. Division 22 and 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing requirements for metal ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.

1. Static-Pressure Classes:

a. Supply Ducts (except in Mechanical Rooms): 2-inch wg.
b. Supply Ducts (Upstream from Air Terminal Units): 3-inch wg.
c. Supply Ducts (Downstream from Air Terminal Units): 1-inch wg.
d. Supply Ducts (in Mechanical Equipment Rooms): 2-inch wg.
e. Return Ducts (Negative Pressure): 1-inch wg.
f. Exhaust Ducts (Negative Pressure): 1-inch wg.

2. Leakage Class:

a. Round Supply-Air Duct: 3 cfm/100 sq. ft. at 1-inch wg.

b. Flat-Oval Supply-Air Duct: 3 cfm/100 sq. ft. at 1-inch wg.
c. Rectangular Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg.
d. Flexible Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.

B. Welding certificates.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

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. Lindab Inc.
    b. McGill AirFlow LLC.
    c. SEMCO Incorporated.
    d. Sheet Metal Connectors, Inc.
    e. Spiral Manufacturing Co., Inc.
    f. Metco.
    g. Prior approved equal.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter (diameter of the round sides connecting the flat portions of the duct).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Lindab Inc.
2. McGill AirFlow LLC.
3. SEMCO Incorporated.
4. Sheet Metal Connectors, Inc.
5. Metco.
6. Prior approved equal.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter (diameter of the round sides connecting the flat portions of the duct) of the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

    a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

    a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
    b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.

E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.

4. Cover insulation with polyester film complying with UL 181, Class 1.

2.4 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.5 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

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

a. CertainTeed Corporation; Insulation Group.
b. Johns Manville.
c. Knauf Insulation.
d. Owens Corning.
e. Prior approved equal.
f. Maximum Thermal Conductivity:

1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
3. Solvent-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

4. Duct insulation shall have a minimum R value = 5 for installation in an unconditioned space, and a minimum R value = 8 for installation outdoors.

B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

    a. Fan discharges.
    b. Intervals of lined duct preceding unlined duct.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

    a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.6 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round and flat-oval ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 22 Section "Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 SEAM AND JOINT SEALING

A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.

1. For static-pressure classes 1- and 1/2-inch wg, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Seal Class C, except as follows:

    a. Ducts that are located directly in zones they serve.

3.3 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 22 and 23 Section "Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual."
2. Test the following systems:

a. Supply air.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before insulation application.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 22 and 23 Section "Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.

4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.7 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel:

B. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.
2. Stainless-Steel Ducts: Galvanized steel.
3. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.

C. Liner:

1. Supply- and Return-Air Ducts: Fibrous glass, Type I.

D. Double-Wall Duct Interstitial Insulation:

1. Supply- and Return-Air Ducts: 1 inch thick.

E. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

a. Velocity 1000 fpm or Lower:

1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

c. Velocity 1500 fpm or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

F. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

G. Duct Schedule

1. Rectangular duct with liner:

a. Low pressure supply and return.

2. Rectangular duct wrapped with insulation:

    a. Low pressure exhaust and fresh air.

3. Single wall round with wrapped insulation.

    a. Low pressure supply and return.

4. Double wall round and flat oval:

    a. Medium pressure supply (upstream of VAV).

END OF SECTION

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SECTION 23 3300

DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Backdraft dampers.
2. Volume dampers.
3. High Efficiency Take-Offs.
4. Motorized control dampers.
5. Fire dampers.
6. Ceiling fire dampers.
7. Smoke dampers.
8. Combination fire and smoke dampers.
9. Turning vanes.
10. Duct-mounting access doors.
11. Flexible connectors.
12. Flexible ducts.
13. Duct accessory hardware.

B. Related Sections include the following:

1. Division 22 and 23 Section "HVAC Instrumentation and Controls" for electric and pneumatic damper actuators.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Backdraft dampers.
2. Volume dampers.
3. High Efficiency Take-Offs.
4. Motorized control dampers.
5. Fire dampers.
6. Ceiling fire dampers.
7. Smoke dampers.
8. Combination fire and smoke dampers.
9. Duct silencers.
10. Turning vanes.
11. Duct-mounting access doors.
12. Flexible connectors.
13. Flexible ducts.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.5 EXTRA MATERIALS

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

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. American Warming and Ventilating.
3. CESCO Products.
4. Duro Dyne Corp.
5. Greenheck.
6. Penn Ventilation Company, Inc.

7. Prefco Products, Inc.
8. Ruskin Company.
9. Tamco
10. Vent Products Company, Inc.
11. Air Rite.
12. Prior approved equal.

B. Description: Multiple-blade, parallel action gravity balanced, with blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.

C. Frame: 0.052-inch- thick, galvanized sheet steel, with welded corners and mounting flange.

D. Blades: 0.025-inch- thick, roll-formed aluminum.

E. Blade Seals: Neoprene.

F. Blade Axles: Galvanized steel.

G. Tie Bars and Brackets: Galvanized steel.

H. Return Spring: Adjustable tension.

2.4 VOLUME DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. American Warming and Ventilating.
3. Clifco
4. Flexmaster U.S.A., Inc.
5. Leader
6. McGill AirFlow Corporation.
7. METALAIRE, Inc.
8. Nailor Industries Inc.
9. Penn Ventilation Company, Inc.
10. Ruskin Company.
11. Vent Products Company, Inc.
12. Air Rite.
13. Greenheck.
14. Prior approved equal.

B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

1. Pressure Classes of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

C. Standard Volume Dampers: Opposed-blade design, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.
3. Aluminum Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
4. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
5. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
6. Blade Axles: Galvanized steel.
7. Bearings: Oil-impregnated bronze.
8. Tie Bars and Brackets: Aluminum.
9. Tie Bars and Brackets: Galvanized steel.

D. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.5 HIGH EFFICIENCY TAKE-OFF

A. Factory-manufactured rectangular-to-round or round-to-round 45 degree leading tap fabricated of 24 ga zinc-coated lockforming quality steel sheets meeting requirements of ASTM A 653, with G-90 coating.

B. One inch wide mounting flange with die formed corner clips, pre-punched mounting holes, and adhesive coated gasket.

C. Manual Volume Damper:

1. Single blade, 22 ga minimum.
2. 3/8 inch minimum square rod with brass damper bearings at each end.
3. Heavy duty locking quadrant on 1-1/2 inch high stand-off mounting bracket attached to side of round duct.

D. Approved Manufacturers:

1. HETD-L by Daniel Manufacturing.
2. STO by Flexmaster USA Inc.
3. HET by Sheet Metal Connectors Inc.
4. Hercules.
5. Clifco
6. Air-Rite.
7. Prior approved equal.

2.6 MOTORIZED CONTROL DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. American Warming and Ventilating.
3. CESCO Products.
4. Duro Dyne Corp.
5. Greenheck.

6. McGill AirFlow Corporation.
7. METALAIRE, Inc.
8. Nailor Industries Inc.
9. Penn Ventilation Company, Inc.
10. Ruskin Company.
11. Tamco
12. Vent Products Company, Inc.
13. Air Rite.
14. Prior approved equal.

B. General Description: AMCA-rated, opposed-blade design; minimum of 0.1084-inch- thick, galvanized-steel frames with holes for duct mounting; minimum of 0.0635-inch- thick, galvanized-steel damper blades with maximum blade width of 8 inches.

1. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F.
3. Provide closed-cell neoprene edging.

2.7 FIRE DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. CESCO Products.
3. Greenheck.
4. McGill AirFlow Corporation.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Penn Ventilation Company, Inc.
8. Prefco Products, Inc.
9. Ruskin Company.
10. Vent Products Company, Inc.
11. Ward Industries, Inc.
12. Prior approved equal.

B. Fire dampers shall be labeled according to UL 555.

C. Fire Rating: 1-1/2 hours.

D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.052 or 0.138 inch thick as indicated and of length to suit application.
2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

I. Fusible Links: Replaceable, 165 deg F rated.

2.8 CEILING FIRE DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. CESCO Products.
3. Greenheck.
4. McGill AirFlow Corporation.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Penn Ventilation Company, Inc.
8. Prefco Products, Inc.
9. Ruskin Company.
10. Vent Products Company, Inc.
11. Ward Industries, Inc.
12. Prior approved equal.

B. General Description: Labeled according to UL 555C; comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."

C. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction.

D. Blades: Galvanized sheet steel with refractory insulation.

E. Fusible Links: Replaceable, 165 deg F rated.

2.9 SMOKE AND COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. CESCO Products.
3. Greenheck.
4. Leader
5. Nailor Industries Inc.
6. Penn Ventilation Company, Inc.
7. Ruskin Company.
8. Prior approved equal.

B. General Description: Labeled according to UL 555S. Combination fire and smoke dampers shall be labeled according to UL 555 for 1-1/2-hour rating.

C. Fusible Links: Replaceable, 165 deg F rated.

D. Frame and Blades: 0.064-inch- thick, galvanized sheet steel.

E. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application.

F. Damper Motors: Modulating and two-position action.

1. Comply with requirements in Division 22 and 23 Section "Motors."
2. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
3. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
4. Outdoor Motors and Motors in Outside-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
5. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
6. Electrical Connection: 115 V, single phase, 60 Hz.

2.10 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

B. Manufactured Turning Vanes: Fabricate 1-1/2-inch- wide, single-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.

1. Available Manufacturers:

a. Ductmate Industries, Inc.
b. Duro Dyne Corp.
c. METALAIRE, Inc.
d. Ward Industries, Inc.
e. Prior approved equal.

C. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.11 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class.

B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.

1. Manufacturers:

a. American Warming and Ventilating.
b. CESCO Products.
c. Ductmate Industries, Inc.
d. Flexmaster U.S.A., Inc.

e. Greenheck.
f. McGill AirFlow Corporation.
g. Nailor Industries Inc.
h. Ventfabrics, Inc.
i. Ward Industries, Inc.
j. Air Rite.
k. Prior approved equal.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Provide number of hinges and locks as follows:

a. Less Than 12 Inches Square: Secure with two sash locks.
b. Up to 18 Inches Square: Two hinges and two sash locks.
c. Up to 24 by 48 Inches: Three hinges and two compression latches.
d. Sizes 24 by 48 Inches and Larger: One additional hinge.

C. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

D. Insulation: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.12 FLEXIBLE CONNECTORS

A. Manufacturers:

1. Ductmate Industries, Inc.
2. Duro Dyne Corp.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.
5. Prior approved equal.

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Select metal compatible with ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd..
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

2.13 FLEXIBLE DUCTS

A. Manufacturers:

1. Flexmaster U.S.A., Inc.
2. Hart & Cooley, Inc.
3. McGill AirFlow Corporation.
4. Themaflex.
5. Quietflex
6. Prior approved equal.

B. Insulated-Duct Connectors: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 210 deg F.

C. Flexible Duct Clamps: **[Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action] [Nylon strap]**, in sizes 3 through 18 inches to suit duct size.

2.14 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

D. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.

E. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.

F. Provide test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers, with fusible links, according to manufacturer's UL-approved written instructions.

H. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:

1. On both sides of duct coils.
2. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
3. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot spacing.
4. On sides of ducts where adequate clearance is available.

I. Install the following sizes for duct-mounting, rectangular access doors:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body Plus Ladder Access: 25 by 17 inches.

J. Install the following sizes for duct-mounting, round access doors:

1. One-Hand or Inspection Access: 8 inches in diameter.
2. Two-Hand Access: 10 inches in diameter.
3. Head and Hand Access: 12 inches in diameter.
4. Head and Shoulders Access: 18 inches in diameter.
5. Body Access: 24 inches in diameter.

K. Label access doors according to Division 22 and 23 Section "Mechanical Identification."

L. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

M. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

O. Connect diffusers to low pressure ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

P. Connect flexible ducts to metal ducts with **[adhesive] [liquid adhesive plus tape] [draw bands] [adhesive plus sheet metal screws]**.

Q. Install duct test holes where indicated and required for testing and balancing purposes.

3.2 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Adjust fire and smoke dampers for proper action.

C. Final positioning of manual-volume dampers is specified in Division 22 and 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION

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SECTION 23 3423

EXHAUST FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Centrifugal roof ventilators.
2. Ceiling Mounting Ventilator.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual Project site elevations.

B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.
2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For power ventilators to include in operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

1.8 EXTRA MATERIALS

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

1. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

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

1. Loren Cook Company ACE-B or equal by
2. Acme Engineering & Mfg. Corp.
3. Aerovent; a Twin City Fan Company
4. American Coolair Corp.
5. Carnes Company HVAC.
6. Greenheck.
7. JencoFan; Div. of Breidert Air Products.
8. Penn Ventilation.
9. Twin City
10. Prior approved equal.

B. Description: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
   1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:

   1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
   2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
   3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
   4. Fan and motor isolated from exhaust airstream.

F. Accessories:

   1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
   2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
   3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
   4. Spring loaded, automatic belt tensioning pulley.

G. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.

   1. Configuration: Built-in cant and mounting flange.
   2. Overall Height: 12 inches.
   3. Sound Curb: Curb with sound-absorbing insulation matrix.
   4. Pitch Mounting: Manufacture curb for roof slope.
   5. Metal Liner: Galvanized steel.
   6. Mounting Pedestal: Galvanized steel with removable access panel.
   7. Vented Curb: Unlined with louvered vents in vertical sides.

H. Capacities and Characteristics: See drawings.

2.2 CEILING-MOUNTING VENTILATORS

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

1. Loren Cook Company. Gemini or equal by.
2. American Coolair Corp.
3. Carnes Company HVAC.
4. Greenheck.
5. JencoFan; Div. of Breidert Air Products.
6. NuTone Inc.
7. Penn Ventilation.
8. Twin City
9. Prior approved equal.

B. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.

C. Housing: Steel, lined with acoustical insulation.

D. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

E. Grille: Plastic, louvered grille with flange on intake and thumbscrew attachment to fan housing.

F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

G. Accessories:

1. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
2. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
3. Motion Sensor: Motion detector with adjustable shutoff timer.
4. Manufacturer's standard roof jack or wall cap, and transition fittings.

H. Capacities and Characteristics: See drawings.

2.3 MOTORS

A. Enclosure Type: Totally enclosed, fan cooled.

2.4 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Support units using restrained spring isolators having a static deflection of 1 inch. Vibration- and seismic-control devices are specified in Division 22 and 23 Section "Mechanical Vibration and Seismic Controls."

1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.

C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

D. Support suspended units from structure using threaded steel rods and spring hangers with vertical-limit stops Insert device having a static deflection of 1 inch. Vibration-control devices are specified in Division 22 and 23 Section "Mechanical Vibration and Seismic Controls."

E. Install units with clearances for service and maintenance.

F. Label units according to requirements specified in Division 22 and 23 Section "Mechanical Identification."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 22 and 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 22 Section "Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding."

D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.

8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION

SECTION 23 3713

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

B. Related Sections include the following:

1. Division 23 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 SUBMITTALS

A. Product Data: For each product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 GRILLES AND REGISTERS

A. Adjustable Bar Side Wall Supply Grille:

1. Products:

a. Carnes; RVEA.
b. Krueger; 5815.
c. METALAIRE, Inc., Metal Industries Inc.; 422.

d. Price Industries; LBMR.
e. Titus; 1707.
f. Tuttle & Bailey; VF5.
g. Or equal by:

1) A-J Manufacturing Co., Inc.
2) Anemostat; a Mestek Company.
3) Dayus Register & Grille.
4) Hart & Cooley, Inc.; Hart & Cooley Div.
5) Nailor Industries of Texas Inc.

2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Adjustable horizontal spaced 1/4 inch apart.
5. Frame: 1 inch wide.

B. Fixed Face Ceiling Return, Exhaust, or Transfer Air Grille:

1. Products:

a. Carnes.
b. Krueger.
c. METALAIRE, Inc., Metal Industries Inc.
d. Price Industries; SPD or equal by.
e. Titus.
f. Tuttle & Bailey.
g. A-J Manufacturing Co., Inc.
h. Anemostat; a Mestek Company.
i. Hart & Cooley, Inc.; Hart & Cooley Div.
j. Nailor Industries of Texas Inc.
k. Prior approved equal.

2. Material: Steel.
3. Finish: Baked enamel, white.

4. Material: Steel.
5. Finish: Baked enamel, white.
6. Face Arrangement: 1/2 inch horizontal blade spacing.
7. Frame: 1-1/4 inches wide.

2.3 CEILING DIFFUSER OUTLETS

A. Rectangular and Square Ceiling Diffusers:

1. Products:

a. Carnes.
b. Krueger.
c. METALAIRE, Inc., Metal Industries Inc.
d. Price Industries; SPD or equal by.
e. Titus.
f. Tuttle & Bailey.
g. A-J Manufacturing Co., Inc.
h. Anemostat; a Mestek Company.
i. Hart & Cooley, Inc.; Hart & Cooley Div.

j. Nailor Industries of Texas Inc.
k. Prior approved equal.

2. Material: Steel.
3. Finish: Baked enamel, white.

2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

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

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, provide lay-in ceiling module. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

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SECTION 23 3714

LOUVERS AND VENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fixed, extruded-aluminum louvers.

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.

C. Vertical Louver: Louver with vertical blades; i.e., the axes of the blades are vertical.

D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

E. Storm-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 PERFORMANCE REQUIREMENTS

A. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

1.5 SUBMITTALS

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

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
2. Show mullion profiles and locations.
3. Wiring Diagrams: For power, signal, and control wiring for motorized adjustable louvers.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of metal finish required.

E. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."
3. AWS D1.6, "Structural Welding Code - Stainless Steel."

C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

D. UL and NEMA Compliance: Provide motors and related components for motor-operated louvers that are listed and labeled by UL and comply with applicable NEMA standards.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Aluminum Castings: ASTM B 26/B 26M, Alloy 319.

D. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.

2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
3. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
4. For fastening stainless steel, use 300 series stainless-steel fasteners.
5. For color-finished louvers, use fasteners with heads that match color of louvers.

E. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Include supports, anchorages, and accessories required for complete assembly.

C. Provide subsills made of same material as louvers or extended sills for recessed louvers.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Nondrainable-Blade Louver:

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

    a. Ruskin Company; Tomkins PLC. Model ELF811 or equa by.
    b. Airolite Company, LLC (The).
    c. American Warming and Ventilating, Inc.; a Mestek company.
    d. Arrow United Industries; a division of Mestek, Inc.
    e. Carnes Company, Inc.
    f. Cesco Products; a division of Mestek, Inc.
    g. Greenheck Fan Corporation.
    h. NCA Manufacturing, Inc.
    i. Pottrof
    j. Prior approved equal.

2. Fabrication: Continuous blade style.

    a. Frame:

        1) Frame Depth: 4 inches (102mm).
        2) Material: Extruded aluminum, Alloy 6063-T5.
        3) Wall Thickness: 0.125 inch (3.2mm), nominal.

    b. Blades:

        1) Style: Horizontal “K”.
        2) Material: Formed aluminum, Alloy 6063-T5.

3) Wall Thickness: 0.125 inch (3.2 mm), nominal.
4) Angle: 45 degrees.
5) Centers: 4-1/2 inches (114 mm), nominal.
6) Continuous Blade Style – Design incorporates visible mullions or frames at the perimeter of the louver only. Rear-mounted hidden blade supports are utilized at section joints and at intermediate locations as needed. Louver blade sightlines are not interrupted at section joints or blade support locations. The rear-mounted blade support depth varies depending on louver height and the design windload.

c. Assembly:

1) Factory assembled louver components. Mechanically fastened construction.

B. Performance Data:

1. Performance Ratings:

a. Based on testing 48 inch by 48 inch (1219 mm by 1219 mm) size unit in accordance with AMCA 500.

2. Free Area: 44 percent, nominal.
3. Maximum Recommended Air Flow through Free Area: 707 feet per minute (214 m/min).
4. Air Flow: 5027 cubic feet per minute (142 cu. m/min).
5. Maximum Pressure Drop (Intake): .06 inches w.g. (14.9 Pa).
6. Water Penetration: Maximum of 0.01 ounces per square foot (3.1 g/sm) of free area at an air flow of 707 feet per minute (214 m/min) free area velocity when tested for 15 minutes.

C. Design Load: Incorporate structural supports required to withstand wind load of:

1. 20 lb/sf (0.96 kPa).
2. Per Code.
3. Louvers shall be factory engineered to withstand the specified seismic loads.

a. Minimum design loads shall be calculated to comply with ASCE – 7, or local requirements of Authority Having Jurisdiction.

2.4 ACCESSORIES

A. Aluminum Insulated Blank-Off Panels: 1 inch (25 mm), aluminum skin, insulated core, factory installed with removable screws and neoprene gaskets.

B. Hinged Frame: Continuous piano hinge attached to angle subframe.

C. Hinged Frame: Continuous piano hinge attached to channel subframe.

D. Bird Screen:

1. Aluminum: Aluminum, 3/4 inch by 0.051 inch (19 mm by 1.3 mm), expanded, flattened.
2. Aluminum: Aluminum, 5/8 inch by 0.040 inch (16 mm by 1 mm), expanded, flattened.

3. Aluminum: Aluminum, 1/2 inch mesh by 0.063 inch (13 mm mesh by 1.6 mm), intercrimp.
4. Steel: Galvanized steel, 1/2 inch mesh by 19 gage (13 mm mesh by 1.1 mm), intercrimp.
5. Frame: Removable, rewireable.

2.5 FINISHES

A. Kynar:

1. Coating shall conform to AAMA 2605. Apply coating following cleaning and pretreatment. Cleaning: AA-C12C42R1X.
2. Standard 2-coat.
3. Pearledize 70 (2-coat mica).

B. 50 percent Floropolymer-Based Painted Finishes:

1. Coating shall conform to AAMA 2604, sections 4.2 and 4.3. Apply coating following cleaning and pretreatment. Cleaning: AA-C12C42R1X.
2. Baked Enamel.
3. Pearledize 50 (2-coat mica).

C. Color for Kynar Finish:

1. Color: Custom. Refer to Drawings.

D. Anodized Finishes:

1. Class 2 Clear Anodized.

a. Comply with Aluminum Association AA-C22A41. Clear anodized finish 215-R1.
b. Apply finish following chemical etching and pretreatment.
c. Minimum Thickness: 0.7 mils (0.018 mm), 60 minute anodizing process.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

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

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

F. Protect unpainted galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 7 Section "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.

B. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

C. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

D. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

DIVISION 26 - ELECTIRAL

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SECTION 26 0500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Raceways.
5. Grout.
6. Common electrical installation requirements.
7. Concrete equipment bases.
8. Building wire and connectors.
9. Supporting devices for electrical components.
10. Electrical identification.
11. Electricity-metering components.
12. Cutting and patching for electrical construction.
13. Touchup painting.
14. Workmanship.
15. Coordination drawings.
16. Rough-ins.
17. Electrical installations.
18. Cutting and patching.
19. Submittals.
20. Record documents.
21. Maintenance manuals.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

C. PVC: Polyvinyl chloride.

D. OSHA: Occupational Safety and Health Administration.

E. NFPA: National Fire Protection Association.

F. EPA: Environmental Protection Agency

G. KW: Kilowatts.

H. NECA: National Electrical Contractor Association

I. EMT: Electrical metallic tubing.

J. FMC: Flexible metal conduit.

K. IMC: Intermediate metal conduit.

L. LFMC: Liquidtight flexible metal conduit.

M. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

B. Product Data: Follow the procedure specified in Division 1 Section “Submittals”.

C. Shop Drawings: Dimensioned plans and sections or elevation layouts of electrical-metering equipment.

D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

E. Additional copies may be required by individual sections of these Specifications.

F. Prepare coordination drawings in accordance with Division 1 Section “Project Coordination”, to a scale of ¼”=1’-0”, or larger; detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installation, and building components. 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.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
5. Clearance for servicing equipment, including space for equipment disassembly required for periodic maintenance.

6. Exterior wall and foundation penetrations.
7. Fire rated wall and floor penetrations.
8. Equipment connections and support details.
9. Sizes and location of required concrete pad and bases.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

D. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

E. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

F. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

G. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

H. Verify voltage, phase and amps of all equipment, prior to rough-in phase of project.

I. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

J. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping".

K. Indicate the proposed locations of the major raceway systems, equipment and materials. Including the following:
1. Clearance for servicing equipment, including space for equipment disassembly required for periodic maintenance.
2. Exterior wall and foundation penetrations.
3. Fire rated wall and floor penetrations.
4. Equipment connections and support details.
5. Sizes and location of required concrete pad and bases.

1.7 WORKMANSHIP

A. All materials and equipment shall be installed in accordance with the recommendations of the manufacturer to conform to the contract documents. The installation shall be accomplished by workmen skilled in the type of work involved.

B. The Electrical Contractor shall have a licensed or certified Master Electrician assigned to direct the electrical work and to coordinate work with the General Contractor and other trades. Furthermore, a licensed or certified journeyman electrician shall be assigned to supervise the actual performance of all electrical work under Division 26. All installers must be certified journeyman.

1. All workmen doing electrical work of any nature must at all times carry their electrician's license with them and show it upon request.

2. The licensed or certified journeyman assigned to supervise the performance of Division 26 electrical work, shall be required to be on the job site at all times, while Division 26 work is being performed.

C. The installation shall conform to the applicable rules of the National Electrical Code and National Electrical Safety Code except where more stringent requirements are noted in these specifications. Conflicts shall be brought to the attention of the Architect/Engineer.

D. The Contractor and Sub-contractors shall comply with OSHA and EPA Standards while in the performance of this contract.

1.8 SUBSTITUTIONS

A. The equipment specified carries brand names and catalog numbers and shall be interpreted as establishing a standard of quality. Use only specified items or those listed by addenda.

B. Any conflict arising from the use of substituted equipment shall be the responsibility of the supplier, who shall bear all costs required to make the equipment comply with the intent of the plans and specifications.

C. At the option of the Architect/Engineer, samples may be required for non-standard items before installation during construction.

D. No materials or apparatus shall be substituted after the bid opening except where the equipment manufacturer has been discontinued or delivery becomes a problem, then written approval of the Architect/Engineer is required.

1.9 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Division 1 Section "PROJECT CLOSEOUT." In addition to the requirements specified in Division 1, indicate installed conditions for:

1. Major raceway systems, size, and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.

2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. PVC Pipe Sleeves: Schedule 40, PVC, plain ends.

B. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

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

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: As required to match the specified roof material interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

B. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

D. Right of Way: Give to piping systems installed at a required slope.

E. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches above finished floor level.

G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants.".

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage

recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 4000-psi, 28-day compressive-strength concrete and reinforcement.

3.5 FIRESTOPPING

A. Apply firestopping to penetrations of cable tray, fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.6 DEMOLITION

A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality at no cost to the owner.

B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.

D. Remove demolished material from Project site.

E. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

F. Contractor shall remove lamps and ballasts from the existing light fixtures and dispose them in the owner furnished containers.

3.7 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

C. Repair conduit and system that have been disturbed or broken, see 3.6B.

3.8 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work, including the following:
   1. Raceways.
   2. Building wire and connectors.
   3. Supporting devices for electrical components.
   4. Electrical identification.
   5. Electricity-metering components.
   6. Concrete bases.
   7. Electrical demolition.
   8. Cutting and patching for electrical construction.

9. Touchup painting.

B. Test Owner's electricity-metering installation for proper operation, accuracy, and usability of output data.
   1. Connect a load of known kW rating, 1.5 kW minimum, to a circuit supplied by the metered feeder.
   2. Turn off circuits supplied by the metered feeder and secure them in the "off" condition.
   3. Run the test load continuously for eight hours, minimum, or longer to obtain a measurable meter indication. Use a test load placement and setting that ensure continuous, safe operation.
   4. Check and record meter reading at end of test period and compare with actual electricity used based on test load rating, duration of test, and sample measurements of supply voltage at the test load connection. Record test results.
   5. Repair or replace malfunctioning metering equipment or correct test setup; then retest. Repeat for each meter in installation until proper operation of entire system is verified.

3.9 REFINISHING AND TOUCHUP PAINTING

A. Refinish and touch up paint. Paint materials and application requirements are specified in Division 9 Section "Painting."

3.10 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 260500

SECTION 26 0519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.
3. Sleeves and sleeve seals for cables.

B. Related Sections include the following:
1. Division 26 Section “Electrical System Testing” for testing of all conductor and cables installations.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

C. NFPA: National Fire Prevention Association

D. ASTM: American Society for Testing and Materials

E. NEMA: National electrical Manufacturers Association

F. NETA: National Educational Telecommunications Association

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.6 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

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

1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Senator Wire & Cable Company.
4. Southwire Company.

B. Refer to Part 3 “Conductor Insulation and Multiconductor Cable Applications and Wiring Methods” Article for insulation type, cable construction and ratings.

C. Copper Conductors: Comply with NEMA WC 70.

D. Conductor Material: Copper complying with NEMA WC 5 stranded conductor. Aluminum conductors are allowed on this project.

E. Conductor Insulation Types indoor use: Type THHN complying with NEMA WC 5.

F. Conductor Insulation Types outdoor use: Type THWN complying with NEMA WC 5.

G. Minimum Conductor Size (power conductors): #12 AWG

H. MC-Cable or Romex cables shall not be used in this project.

2.2 CONNECTORS AND SPLICES

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

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

C. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

D. Conductor Material: Copper complying with NEMA WC 5 stranded conductor. Aluminum conductors are not allowed on this project.

E. Conductor Insulation Types: Type THHN-THWN complying with NEMA WC 5.

F. Minimum Conductor Size (power conductors): #12 AWG.

2.3 SLEEVES FOR CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.138-inch thickness as indicated and of length to suit application.

C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.4 SLEEVE SEALS

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

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: As required for the specified materials interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Carbon steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

C. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Carbon steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Stranded for all conductor sizes, unless otherwise indicated.

B. Branch Circuits: Copper. Provide solid conductors for power and lighting circuits no. 10 AWG and smaller. Provide stranded conductors for sizes no. 8 AWG and larger. All control conductors shall be THHN/THWN stranded in raceway. Motor loads shall be stranded copper..

C. Aluminum conductors are not allowed on this project.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN, single conductors in raceway .

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Feeders Concealed in Concrete, 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 Crawlspaces: 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. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

K. Fire Alarm Circuits: Type THHN-THWN, in single raceway, unless specified otherwise in Section 28, ”Digital, Addressable Fire Alarm System”.

L. Class 1 Control Circuits: Type THHN-THWN, in raceway.

M. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

G. Seal around cables penetrating fire-rated elements according to Division 7 Section "Through-Penetration Firestop Systems."

H. Clean conduits with a 95% mandrel, prior to installation of conductors.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both wall surfaces. (Public Areas)

G. Extend sleeves installed in floors 2 inches above finished floor level. (Utility Areas)

H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.

M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal underground exterior-wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. 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.

2. Prior to energizing, check installed wires and cables with megaohm meter to determine insulation resistance levels to assure requirements are fulfilled.

3. Provide written documents for all Megger testing.

4. Prior to energizing, test wires and cables for electrical continuity and for short-circuits.

5. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Remove and replace malfunctioning units and retest as specified above.

D. Refer to "Commissioning Specification" sections for project commissioning requirements.

END OF SECTION 26 0519

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SECTION 26 0526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment., plus the following special applications:
   1. Underground distribution grounding.

B. Related Sections include the following:
   1. Division 2 Section "Underground Ducts and Utility Structures" for ground test wells.

1.3 SUBMITTALS

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

B. Other Informational Submittals: Plans showing dimensioned locations of proposed grounding features specified in Part 3 "Field Quality Control" Article, including the following:
   1. Ground rods.
   2. Grounding arrangements and connections for separately derived systems.

1.4 QUALITY ASSURANCE

A. Comply with UL 467 for grounding and bonding materials and equipment.

B. Comply with NFPA 70; for medium-voltage underground construction, comply with IEEE C2.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

   1. Grounding Conductors, Cables, Connectors, and Rods:
      a. Chance/Hubbell.
      b. Copperweld Corp.
      c. Erico Inc.; Electrical Products Group.
      d. Framatome Connectors/Burndy Electrical.
      e. Harger Lightning Protection, Inc.
      f. Heary Brothers Lightning Protection Co.

g. Kearney/Cooper Power Systems.
h. Korns: C. C. Korns Co.; Division of Robroy Industries.
i. Lyncole XIT Grounding.
j. O-Z/Gedney Co.; a business of the EGS Electrical Group.
k. Raco, Inc.; Division of Hubbell.
l. Thomas & Betts, Electrical.

2.2 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
1. Stranded Conductors: ASTM B 8.
2. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
3. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
4. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
5. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus:
1. Rectangular bars of annealed copper, 1/4 by 2 inches by 14 inches in cross section, unless otherwise indicated; with insulators.

2.3 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

1. Non Reversible Crimps

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions required at the grounding rods.

2.4 GROUNDING ELECTRODES

A. Ground Rods: stainless steel; 3/4 inch by 10 feet in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Stranded for all conductor sizes, unless otherwise indicated.

B. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

C. In raceways, use insulated equipment grounding conductors.

D. Exothermic-Welded Connections: Use for underground connections, except those at test wells.

E. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

F. Grounding Bus: Install in all electrical and all telephone equipment rooms, in rooms housing service equipment, under all raised floors and elsewhere as indicated.
   1. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.
   2. At doors, route the bus up to the top of the doorframe, across the top of the doorway, and down to the specified height above the floor.

G. Underground Grounding Conductors: Use tinned- copper conductor, No. #2 AWG Bare CU minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

H. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 3/0 AWG minimum or as shown on the plans.

   1. Bury at least 24 inches below grade.

I. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

   1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.

J. 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 Structural Steel: Non Reversible Crimp.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Coordinate with Drawings and with Division 26 Section "Underground Ducts and Raceways for Electrical Systems.".

C. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches 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 No. 4 AWG minimum, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

E. Pad-Mounted Transformers and Switches: Install two ground rods around the 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 No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.3 EQUIPMENT GROUNDING

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install insulated equipment grounding conductors with all feeders and branch circuits.

C. 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. 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.

D. Computer Outlet Circuits: Install insulated equipment-grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.

E. Nonmetallic Raceways: Install an equipment-grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

F. Air-Duct Equipment Circuits: Install an equipment-grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.

G. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment-grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.

H. 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.

I. Signal and Communication Equipment: 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.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

J. Metal 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.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods:
   1. Drive ground rods until tops are 12 inches below finished floor or final grade, unless otherwise indicated.
   2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
   3. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
   4. For grounding electrode system, install at least two 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.
   5. Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

   1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
   2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
   3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

E. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

F. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.5 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Tighten screws and bolts for grounding and bonding 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.

F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.6 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

A. Manholes and Handholes: Install a driven ground rod close to wall and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

B. Connections to Manhole Components: Connect 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 No. 4 AWG minimum, stranded, hard-drawn copper conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

C. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise circling pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Use tinned-copper conductor not less than No. 2 AWG for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 inches below grade and 6 inches from the foundation.

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

END OF SECTION 26 0526

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SECTION 26 0529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

B. Related Sections include the following:

1. Division 26 Section "Vibration And Seismic Controls For Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Nonmetallic slotted channel systems. Include Product Data for components.
4. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

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

      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

2.2 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 Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 3/8 inch in diameter.

C. 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 single-bolt conduit clamps using spring friction action for retention in support channel.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 3/4inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

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. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
6. To Light Steel: Sheet metal screws.
7. 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 meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

F. Support structure width shall be 24 inches (min), unless specified otherwise.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches 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, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 0529

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SECTION 26 0533

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. FMC: Flexible metal conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquidtight flexible metal conduit.

G. LFNC: Liquidtight flexible nonmetallic conduit.

H. NBR: Acrylonitrile-butadiene rubber.

I. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.
2. For handholes and boxes for underground wiring, including the following:

a. Duct entry provisions, including locations and duct sizes.
b. Frame and cover design.
c. Grounding details.
d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
e. Joint details.

C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members in the paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

D. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will retain its enclosure characteristics, including its interior accessibility, after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Qualification Data: For professional engineer and testing agency.

F. Source quality-control test reports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

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

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.

4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

E. EMT: ANSI C80.3.

F. FMC: Zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket.

H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT:
   a. Steel, set-screw type in interior/dry locations.
   b. Utilize steel, compression type in damp or exterior locations.
3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.

I. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

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

1. Arnco Corporation.
2. Endot Industries Inc.
3. IPEX Inc.
4. Lamson & Sessions; Carlon Electrical Products.

B. Description: Comply with UL 2024; flexible type, approved for plenum installation.

2.3 METAL WIREWAYS

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

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type or As indicated.

E. Finish: Manufacturer's standard enamel finish.

F. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.4 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect/Engineer.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Thomas & Betts Corporation.
b. Walker Systems, Inc.; Wiremold Company (The).
c. Wiremold Company (The); Electrical Sales Division.

2.5 BOXES, ENCLOSURES, AND CABINETS

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

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with SCTE 77.

1. Color of Frame and Cover: Gray.
2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC, “COMMUNICATION,” or as indicated for each service.
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
7. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Fiberglass Handholes and Boxes with Polymer-Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester-resin enclosure joined to polymer-concrete top ring or frame.
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. Armorcast Products Company.
b. Carson Industries LLC.
c. Christy Concrete Products.
d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.
e. Quazite.

2.7 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.138” thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.8 SLEEVE SEALS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Carbon steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.9 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit or IMC.
2. Concealed Conduit, Aboveground: Rigid steel conduit or IMC.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried. Conduit bends over 22 deg. must be rigid steel.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
6. Minimum Raceway Size: 1-inch trade size.
7. Application of Handholes and Boxes for Underground Wiring:

a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Fiberglass enclosures with polymer-concrete frame and cover, SCTE 77, Tier 15 structural load rating.
b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Heavy-duty fiberglass units with polymer-concrete frame and cover, SCTE 77, Tier 8 structural load rating.

c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.

B. Comply with the following indoor applications, unless otherwise indicated:
1. Minimum Raceway Size: 3/4-inch trade size.
2. Exposed, Not Subject to Physical Damage: EMT.
3. Exposed, Not Subject to Severe Physical Damage: EMT.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: Rigid steel conduit or IMC.
7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical fiber/communications cable raceway or EMT.
8. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: Riser-type, optical fiber/communications cable raceway or EMT.
9. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: Plenum-type, optical fiber/communications cable raceway or EMT.
10. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

C. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

D. Aluminum conduits are not permitted on project.

3.2 INSTALLATION

A. Keep raceways at least 12 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

B. Complete raceway installation before starting conductor installation.

C. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

D. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

E. Install temporary closures to prevent foreign matter from entering raceways.

F. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

G. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

H. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

I. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical.

J. Run exposed, parallel, or banked raceways together. Make bends in parallel or banked runs from the same center line so that the bends are parallel. Factory long sweep on medium voltage elbows may be used in banked runs only where they can be installed parallel. This requires raceways be o fht esame size. In other cases provide field bends for parallel raceways.

K. Install no more than the equivalent of four 90-degree bends in any conduit run except for communications conduits, for which no more than two 90-degree bends are allowed.

L. Conceal conduit and EMT within finished walls, ceilings, and below floors, unless otherwise indicated.

M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

N. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

O. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
   1. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 100 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements. Follow the ANSI/TA/EIA-569-B standards. Conduit to end withing 12 inches of cable tray with a bend toward IDF room. Provide throat type or equal type plastic bushing.

P. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; LFMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

Q. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:

   1. 1-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
   2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
   3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

R. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where otherwise required by NFPA 70.

S. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.

1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F temperature change.
    d. Attics: 135 deg F temperature change.

2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.
3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

T. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

U. 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.

V. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.

W. Set metal floor boxes level and flush with finished floor surface.

X. Join raceways with fittings designed and approved for that purpose and make joints tight.
1. Use insulating bushings to protect conductors.

Y. Tighten set screws of threadless fittings with suitable tools.

Z. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

AA. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

BB. Run a 95% mandril through each conduit, prior to the installation of conductors.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches

of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."

4. Install manufactured duct elbows at vault entrances, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install handholes and boxes with bottom below the frost line, below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both surfaces of walls.

G. Extend sleeves installed in floors 2 inches above finished floor level.

H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed or unless seismic criteria require different clearance.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.8 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 0533

SECTION 26 0543

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to Section 260526 “Grounding And Bonding For Electrical Systems.”

1.2 SUMMARY

A. This Section includes the following:

1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.
2. Handholes and boxes.
3. Manholes.

1.3 DEFINITION

A. RNC: Rigid nonmetallic conduit.

B. Product Data: For the following:

1. Duct-bank materials, including separators and miscellaneous components.
2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Accessories for manholes, handholes, boxes, and other utility structures.
4. Warning tape.

C. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Reinforcement details.
3. Frame and cover design and manhole frame support rings.
4. Ladder details.
5. Grounding details.
6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
7. Joint details.

D. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Cover design.

3. Grounding details.
4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

E. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858.

F. Source quality-control test reports.

G. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.

1.7 COORDINATION

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.

B. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

C. Provide RIGID steel 90 degree pre-manufactured elbows for all locations.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. ARNCO Corp.
2. Beck Manufacturing.
3. Cantex, Inc.
4. CertainTeed Corp.; Pipe & Plastics Group.
5. Condux International, Inc.
6. ElecSys, Inc.
7. Electri-Flex Company.
8. IPEX Inc.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT; a division of Cable Design Technologies.
11. Spiraduct/AFC Cable Systems, Inc.

B. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."

2.3 PRECAST CONCRETE HANDHOLES AND BOXES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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

1. Carder Concrete Products.
2. Christy Concrete Products.
3. Elmhurst-Chicago Stone Co.
4. Oldcastle Precast Group.
5. Riverton Concrete Products; a division of Cretex Companies, Inc.
6. Utility Concrete Products, LLC.
7. Utility Vault Co.
8. Wausau Tile, Inc.
9. Duracrete (Phone: 801-9728686).

C. Comply with ASTM C 858 for design and manufacturing processes.

D. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.

1. Frame and Cover: Weatherproof aluminum frame with hinged aluminum access door assembly with tamper-resistant, captive, cover-securing bolts manufactured by Syracuse.

a. Cover Hinges: Concealed, with hold-open ratchet assembly.
b. Cover Handle: Recessed.

E. Coordinate remaining subparagraphs and associated subparagraphs below with Drawings.

1. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
2. Cover Legend: Molded lettering, "ELECTRIC."
3. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
4. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.

a. Extension shall provide increased depth of 12 inches.
b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.

5. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.

a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.

6. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

a. Type and size shall match fittings to duct or conduit to be terminated.
b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.

7. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.4 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Description: Comply with SCTE 77.

1. Color: Gray.
2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.

4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC."
6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

B. Fiberglass Handholes and Boxes with Polymer Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.
1. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:

a. Armorcast Products Company.
b. Carson Industries LLC.
c. Christy Concrete Products.
d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.
e. Quazite

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of polymer concrete.
1. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:

a. Carson Industries LLC.
b. Christy Concrete Products.
c. Nordic Fiberglass, Inc.

D. High-Density Plastic Boxes: Injection molded of high-density polyethylene or copolymer-polypropylene. Cover shall be polymer concrete.
1. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:

a. Carson Industries LLC.
b. Nordic Fiberglass, Inc.
c. PenCell Plastics.

2.5 PRECAST MANHOLES

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

1. Carder Concrete Products.
2. Christy Concrete Products.
3. Elmhurst-Chicago Stone Co.
4. Oldcastle Precast Group.
5. Riverton Concrete Products; a division of Cretex Companies, Inc.
6. Utility Concrete Products, LLC.
7. Utility Vault Co.
8. Wausau Tile, Inc.

B. Comply with ASTM C 858, with structural design loading as specified in Part 3 "Underground Enclosure Application" Article and with interlocking mating sections, complete with accessories, hardware, and features.

1. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.

a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.

2. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

a. Type and size shall match fittings to duct or conduit to be terminated.
b. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes to facilitate racking of cable.

C. Concrete Knockout Panels: 1-1/2 to 2 inches thick, for future conduit entrance and sleeve for ground rod.

D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.6 CAST-IN-PLACE MANHOLES

A. Description: Underground utility structures, constructed in place, complete with accessories, hardware, and features. Include concrete knockout panels for conduit entrance and sleeve for ground rod.

B. Materials: Comply with ASTM C 858 and with Division 03 Section "Cast-in-Place Concrete."

C. Structural Design Loading: As specified in Part 3 "Underground Enclosure Application" Article.

2.7 UTILITY STRUCTURE ACCESSORIES

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

1. Syracuse

B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.

1. Frame and Cover: Weatherproof, cast aluminum with milled cover-to-frame bearing surfaces; diameter.

a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.

2. Cover Legend: Cast in. Selected to suit system.
   a. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.

3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.

   a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C 387, Type M, may be used.

C. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.

D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch-diameter eye, and 1-by-4-inch bolt.

1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.

E. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4-inch-diameter eye, rated 2500-lbf minimum tension.

F. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch-diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.

1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.

G. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.

1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.

H. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.

I. Cable Rack Assembly: Steel, hot-dip galvanized, except insulators.

1. Stanchions: T-section or channel; 2-1/4-inch nominal size; punched with 14 holes on 1-1/2-inch centers for cable-arm attachment.
2. Arms: 1-1/2 inches wide, lengths ranging from 3 inches with 450-lb minimum capacity to 18 inches with 250-lb minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.
3. Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.

J. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

K. Fixed Manhole Ladders: Arranged for attachment to roof or wall and floor of manhole. Ladder and mounting brackets and braces shall be fabricated from hot-dip galvanized steel.

L. PCover Hooks: Heavy duty, designed for lifts 60 lbf and greater. Two required.

2.8 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C 1037.

B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
   1. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
   2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Cables Over 600 V: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

C. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

D. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

E. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

F. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, installed in direct-buried or concrete-encased duct bank, unless otherwise indicated.

G. Underground Ducts for Telephone, Communications, or Data Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

H. Underground Ducts for Telephone, Communications, or Data Circuits: RNC, NEMA Type EB-20-PVC, in concrete-encased duct bank, unless otherwise indicated.

I. Underground Ducts Crossing Paved Paths, Walks and Roadways: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

3.2 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less, Including Telephone, Communications, and Data Wiring:

1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
4. Units Subject to Light-Duty Pedestrian Traffic Only: Polymer concrete units, SCTE 77, Tier 8, structurally tested according to SCTE 77 with 3000-lbf vertical loading.

B. Manholes: Precast or cast-in-place concrete.

1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3.3 EARTHWORK

A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Sections "Turf and Grasses" and "Plants."

D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section "Cutting and Patching."

3.4 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, 12.5 feet, both horizontally and vertically, at other locations, unless otherwise indicated.

C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.

3. Grout end bells into structure walls from both sides to provide watertight entrances.

E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Common Work Results for Electrical."

F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

G. Pulling Cord: Install 100-lbf-test nylon cord in ducts, including spares.

H. Concrete-Encased Ducts: Support ducts on duct separators.

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

    a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
    b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.

3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
6. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts, unless specified otherwise.
7. Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated or as indicated on the plans.
8. Stub-Ups: Use manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Extend concrete encasement throughout the length of the elbow.
9. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.

10. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

3.5 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Cast-in-Place Manhole Installation:

1. Finish interior surfaces with a smooth-troweled finish.
2. Windows for Future Duct Connections: Form and pour concrete knockout panels 1-1/2 to 2 inches thick, arranged as indicated.
3. Cast-in-place concrete, formwork, and reinforcement are specified in Division 03 Section "Cast-in-Place Concrete."

B. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891, unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevations:

1. Manhole Roof: Install with rooftop at least 15 inches below finished grade.
2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
3. Install handholes with bottom below the frost line, below grade.
4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
5. Where indicated, cast handhole cover frame integrally with handhole structure.

D. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

E. Materials and fabrication: Furnish each access door assembly manufactured as integral unit, complete with all parts and ready for installation.
1. Locking Devices: Furnish flush, screwdriver-operated cam locks number required to hold door in flush smooth plane when closed.
2. Provide one cylinder lock per access door. Furnish 2 keys per lock. Key all locks alike, unless otherwise scheduled.

F. Manhole Access: Rectangular opening in manhole roof; sized to match cover size.

1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.

2. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.

G. Waterproofing: Apply waterproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Waterproofing materials and installation are specified in Division 07 Section "Elastomeric Sheet Waterproofing or Thermoplastic Sheet Waterproofing." After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.

H. Dampproofing: Apply dampproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Dampproofing materials and installation are specified in Division 07 Section "Bituminous Dampproofing." After ducts have been connected and grouted, and before backfilling, dampproof joints and connections and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.

I. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, as required for installation and support of cables and conductors and as indicated.

J. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes, unless indicated otherwise.

K. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

L. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch above finished grade.

D. Install handholes and boxes with bottom below the frost line, below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

G. For enclosures installed in asphalt paving or concrete slab and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.

1. Concrete: 3000 psi, 28-day strength, complying with Division 03 Section "Cast-in-Place Concrete," with a troweled finish.
2. Dimensions: 10 inches wide by 12 inches deep.

3.7 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

2. Pull aluminum or wood mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.9 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 26 0543

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SECTION 26 0548

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Spring isolators.
3. Restrained spring isolators.
4. Channel support systems.
5. Restraint cables.
6. Hanger rod stiffeners.
7. Anchorage bushings and washers.

B. Related Sections include the following:

1. Division 26 Section "Hangers And Supports For Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

A. The IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: Coordinate with structural documents.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III.

a. Component Importance Factor: Per Structural requirement..
b. Component Response Modification Factor: Per Structural requirement..
c. Component Amplification Factor Per Structural requirement..

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): .
4. Design Spectral Response Acceleration at 1.0-Second Period:

1.5 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
    a. Annotate to indicate application of each product submitted and compliance with requirements.

3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.

    a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 26 Sections for equipment mounted outdoors.

2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
3. Field-fabricated supports.
4. Seismic-Restraint Details:

    a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
    b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Welding certificates.

E. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or

preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

D. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate layout and installation of seismic bracing with building structural system and architectural features, and with mechanical, fire-protection, electrical, and other building features in the vicinity.

B. Coordinate concrete bases with building structural system.

PART 2 - PRODUCTS

2.1 SEISMIC-RESTRAINT DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti Inc.
5. Loos & Co.; Seismic Earthquake Division.
6. Mason Industries.
7. TOLCO Incorporated; a brand of NIBCO INC.
8. Unistrut; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an evaluation service member of ICC-ES.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

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

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.

F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.

G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.2 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

A. Coordinate products in this Article with structural engineer and with Drawings.

B. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to authorities having jurisdiction.
   1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.

C. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type.

D. Concrete Inserts: Steel-channel type.

E. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.

F. Welding Lugs: Comply with MSS SP-69, Type 57.

G. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.

H. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.

I. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

   1. Powder coating on springs and housings.
   2. All hardware shall be galvanized.
   3. Hot-dipped galvanize metal components for exterior use.

4. Corrosive Locations: Stainless Steel.
5. Baked enamel or powder coat for metal components on isolators for interior use.
6. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment and Hanger Restraints:

1. Install restrained isolators on electrical equipment.
2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.

B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

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

D. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are

encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ELECTRICAL EQUIPMENT ANCHORAGE

A. Anchor rigidly to a single mobile structural element or to a concrete base that is structurally tied to a single mobile structural element.

B. Anchor panelboards, motor-control centers, motor controls, switchboards, switchgear, transformers, fused power-circuit devices, transfer switches, busways, battery racks, static uninterruptible power units, power conditioners, capacitor units, communication system components, and electronic signal processing, control, and distribution units as follows:
1. Size concrete bases so expansion anchors will be a minimum of 10 bolt diameters from the edge of the concrete base.
2. Concrete Bases for Floor-Mounted Equipment: Use female expansion anchors and install studs and nuts after equipment is positioned.
3. Bushings for Floor-Mounted Equipment Anchors: Install to allow for resilient media between anchor bolt or stud and mounting hole in concrete.
4. Anchor Bolt Bushing Assemblies for Wall-Mounted Equipment: Install to allow for resilient media where equipment or equipment-mounting channels are attached to wall.
5. Torque bolts and nuts on studs to values recommended by equipment manufacturer.

C. STRUCTURAL ATTACHMENTS
1. Use bolted connections with steel brackets, slotted channel, and slotted-channel fittings to spread structural loads and reduce stresses.
2. Attachments to New Concrete: Bolt to channel-type concrete inserts or use expansion anchors.
3. Attachments to Existing Concrete: Use expansion anchors.
4. Holes for Expansion Anchors in Concrete: Drill at locations and to depths that avoid reinforcing bars.
5. Attachments to Solid Concrete Masonry Unit Walls: Use expansion anchors.
6. Attachments to Hollow Walls: Bolt to slotted steel channels fastened to wall with expansion anchors.
7. Attachments to Wood Structural Members: Install bolts through members.
8. Attachments to Steel: Bolt to clamps on flanges of beams or on upper truss chords of bar joists.

3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different

structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Remove and replace malfunctioning units and retest as specified above.

C. Testing: Test pull-out resistance of seismic anchorage devices.
1. Provide necessary test equipment required for reliable testing.
2. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
3. Retain subparagraphs below with any paragraph selected above.
4. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
5. Obtain Architect's approval before transmitting test loads to the structure. Provide temporary load-spreading members.
6. Edit sampling frequency in subparagraph below to suit Project.
7. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
8. Test to 90 percent of rated proof load of device.
9. If a device fails the test, modify all installations of same type and retest until satisfactory results are achieved.
10. Record test results.

3.7 ADJUSTING

A. Adjust isolators after isolated equipment is at operating weight.

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

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.8 ELECTRICAL VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

A. Supported or Suspended Equipment:

1. Equipment Location: as required.
2. Pads:

    a. Material: Neoprene.
    b. Thickness: ¼ inches.

3. Isolator Type: As designated in Part 2.
4. Component Importance Factor: Per Structural requirement..
5. Component Response Modification Factor: Per Structural requirement..
6. Component Amplification Factor: Per Structural requirement..

END OF SECTION 26 0548

SECTION 26 0553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products, as requested by owner.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less (see 3.1F):

1. Black letters on an orange field.
2. Legend: Indicate system or service and voltage.

C. Colors for Raceways Carrying Circuits at More Than 600 V (see 3.1F):

1. Black letters on an orange field.
2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch-high letters on 20-inch centers.

D. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch-wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.

E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape, not less than 3 mils thick by 1 to 2 inches wide. Conductors in sizes #6 and below shall be color coded with the colored insulation. Larger sizes may be identified with colored tape.

2.4 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Tag: Type ID (warning tape with metal core):

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Overall Thickness: 5 mils.
3. Foil Core Thickness: 0.35 mil.
4. Weight: 28 lb/1000 sq. ft.
5. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

2.5 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR:"
   a. Working Voltage 208V: 36 inches.
   b. Working Voltage 480V: 48 inches.
   c. Working Voltage 4160V: 60 inches.
   d. Working Voltage 12,470V: 10 feet.
   e. Working Voltage 46,000V: 10 feet.

2.6 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

2.7 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.8 CABLE TIES

A. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.

F. Color Banding Raceways and Exposed Cables: Band exposed and accessible raceways of the systems listed below:
   1. Bands: Pretensioned, wraparound plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
   2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
   3. Apply the following colors to the systems listed below:

      a. Fire-Alarm System: Red.
      b. Fire-Suppression Supervisory and Control System: Red and yellow.
      c. Combined Fire-Alarm and Security System: Red and blue
      d. Security System: Purple
      e. Mechanical and Electrical Supervisory System: Green and blue.
      f. Telecommunications System: Blue
      g. Emergency power system: Yellow.
      h. 277/480 volts system: Brown.
      i. 120/208 volts system: Black.
      j. Clocks & Bells: Orange.
      k. Sound System: Green.
      l. Traveler (switch to light or switch to switch) 120 volts: Pink
      m. Traveler (switch to light or switch to switch) 277 volts: Purple
      n. Lighting control and dimmers systems: White.

G. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

   1. Outdoors: UV-stabilized nylon.
   2. In Spaces Handling Environmental Air: Plenum rated.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench. Extend metal tape cable to inside transformer low voltage enclosure.

J. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

K. Circuit Identification Labels on Boxes: Install labels externally.
   1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
   2. Concealed Boxes: Plasticized card-stock tags.
   3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.

3.2 IDENTIFICATION SCHEDULE

A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch-wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH

VOLTAGE WIRING" with 3-inch-high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Snap-around labels. Install labels at 10-foot maximum intervals.

C. Accessible Raceways, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with color conduit. Install labels at 10-foot maximum intervals.

D. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.
2. Power.

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

   a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG.
   b. Colors for 208/120-V Circuits:
      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
      4) Neutral : White
      5) Ground : Green
      6) Isolated Ground: White & Green
      7) Control: Violet

   c. Fire Alarm-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes and enclosures, use factory colored cables and conductors to identify the individual circuits. All conductors shall be stranded.

F. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:

   a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
   b. Colored cable ties applied in groups of three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3

inches apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.

G. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.

H. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

I. Apply identification to conductors as follows:
1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.

J. Apply warning, caution, and instruction signs as follows:
1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch- high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

K. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

L. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

M. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

N. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

O. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.

4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

    a. Power transfer switches.
    b. Controls with external control power connections.

P. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

Q. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

R. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

    a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
    b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
    c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

    a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved label.
    b. Enclosures and electrical cabinets.
    c. Switchgear.
    d. Switchboards.
    e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    f. Emergency system boxes and enclosures.
    g. Motor-control centers.
    h. Enclosed switches.
    i. Enclosed circuit breakers.
    j. Enclosed controllers.
    k. Contactors.
    l. Panelboards, electrical cabinets, and enclosures.
    m. Emergency system boxes and enclosures.
    n. Disconnect switches.
    o. Enclosed circuit breakers.
    p. Control devices.

END OF SECTION 26 0553

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SECTION 26 0923

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related section 019113 General Commissioning Requirements.

C. Commissioning of this equipment is required per specification 019113.

1.2 SUMMARY

A. This Section includes the following lighting control devices:

1. Time switches.
2. Indoor occupancy sensors.
3. Lighting contactors.
4. Emergency shunt relays.

B. Related Sections include the following:
1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.4 SUBMITTALS

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

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Provide factory layout drawings showing best placement of devices. Locations shall be coordinated with other ceiling devices and air diffusers.

2. Interconnection diagrams showing field-installed wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

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 system, and partition assemblies.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS, DIMMING SYTEM AND CONTROL

A. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
   1. Watt Stopper (The).
   2. Acuity
   3. ETC
   4. Douglas
   5. Cooper
   6. Acuity
   7. ETC
   8. Douglas
   9. Copper

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

   1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
   2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
   3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
   4. Mounting:

      a. Sensor: Suitable for mounting in any position on a standard outlet box.
      b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
      c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

   5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
   6. Bypass Switch: Override the on function in case of sensor failure.
   7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.

C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.

1. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot-high ceiling.

D. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch-high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch-high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot-high ceiling in a corridor not wider than 14 feet.

E. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be 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-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

2.2 LIGHTING CONTACTORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:

1. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
3. Square D; Schneider Electric.
4. TORK.
5. Touch-Plate, Inc.
6. Watt Stopper (The).

B. Description: Electrically operated and mechanically held, combination type with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).

2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 3/4 inch.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaries 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. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements. Provide a written report of test results and sensor sensitivity/time delay settings.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26 Section "Network Lighting Controls."

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 26 0923

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SECTION 26 2726

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Receptacles with integral surge suppression units.
4. Snap switches and wall-box dimmers.
5. Wall-switch.
6. Pendant cord-connector devices.
7. Cord and plug sets.
8. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Provide a sample of each type of device to be used.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 5351 (single), 5352 (duplex).
b. Hubbell; HBL5351 (single), CR5352 (duplex).
c. Leviton; 5891 (single), 5352 (duplex).
d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; GF20.
    b. Pass & Seymour; 2084.

2.4 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; L520R.
    b. Hubbell; HBL2310.
    c. Leviton; 2310.
    d. Pass & Seymour; L520-R.

3. Verify voltage and Amperage.

2.5 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

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

    a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
    b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
    c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
    d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

2. All devices are to be décor type.

2.6 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Stainless steel.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates:

1. NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.
2. NEMA 3R-in-Use cover, plastic, weather resistant.

2.7 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular die-cast aluminum with satin finish.

D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Blank cover with bushed cable opening.

2.8 MULTIOUTLET ASSEMBLIES

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

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Wiremold Company (The).

B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

C. Raceway Material: Aluminum, with standard selected finish.

D. Wire: No. 12 AWG.

E. Provide engraved circuit number for each outlet.

2.9 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: Gray, unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. TVSS Devices: Blue.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use engraved machine printing with black-filled lettering on face, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 26 2726

SECTION 26 2813

FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Cartridge fuses rated 600-V ac and less for use in enclosed switches, and enclosed controllers.
2. Plug fuses rated 125-V ac and less for use in plug-fuse-type enclosed switches and fuseholders.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

B. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
1. Let-through current curves for fuses with current-limiting characteristics.
2. Time-current curves, coordination charts and tables, and related data.
3. Fuse size for elevator feeders and elevator disconnect switches.

C. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

1. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

D. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

a. Let-through current curves for fuses with current-limiting characteristics.
b. Time-current curves, coordination charts and tables, and related data.
c. Ambient temperature adjustment information.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA FU 1.

D. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

1.7 EXTRA MATERIALS

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

1. Fuses: Quantity equal to 5 percent of each fuse type and size, but no fewer than 2 of each type and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Cooper Bussmann, Inc.
2. Ferraz Shawmut, Inc.
3. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. NEMA FU 1 class is same as UL class. Class defines fuse performance category, including interrupting rating. See Editing Instruction No. 2 in the Evaluations.

B. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

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

D. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

E. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

3.2 FUSE APPLICATIONS

1. Motor Branch Circuits: Class RK1, time delay.
2. Control Circuits: Class CC, fast acting.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 2813

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SECTION 26 2816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Molded-case switches.
7. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.

5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Qualification Data: For qualified testing agency.

D. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source 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 as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E.

1.8 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
1. Siemens Energy & Automation, Inc.
2. Square D; a brand of Schneider Electric.
3. General Electric Company.
4. Cuttler-Hammer.

B. Provide fusible switches with quantity of poles and amperage, as indicated on the drawings.

C. Type HD, Heavy Duty, Single Throw, [600]-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. 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. Internally mounted; insulated, capable of being grounded and bonded; 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. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.

6. Allows use of a hookstick to operate the handle.
7. Lugs: Mechanical type, suitable for number, size, and conductor material.
8. Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
   1. Siemens Energy & Automation, Inc.
   2. Square D; a brand of Schneider Electric.

B. Provide fusible switches with quantity of poles and amperage, as indicated on the drawings.

C. Type HD, Heavy Duty, 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.

D. 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. Mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
   5. Allows use of a hookstick to operate the handle.
   6. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
   1. Siemens Energy & Automation, Inc.
   2. Square D; a brand of Schneider Electric.
   3. General Electric Company.
   4. Cuttler-Hammer

B. Show pole quantities and voltage and ampere ratings of MCCBs and switches on Drawings.

C. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

D. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

E. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

F. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

G. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
6. Alarm Switch: One NO/NC contact that operates only when circuit breaker has tripped.

2.4 MOLDED-CASE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
1. Siemens Energy & Automation, Inc.
2. Square D; a brand of Schneider Electric.
3. General Electric Company.
4. Cuttler-Hammer

B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
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. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
6. One NO/NC contact that operates only when switch has tripped.
7. Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
8. Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
9. Provide remote control for on, off, and reset operations.

2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R
3. NEMA 250, Type 4X, stainless steel.

4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study".

END OF SECTION 26 2816

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SECTION 26 5100

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related section 019113 General Commissioning Requirements.

C. Commissioning of this equipment is required per specification 019113.

1.2 SUMMARY

A. This Section includes the following:

1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.
5. Retrofit kits for fluorescent lighting fixtures.

B. Related Sections include the following:

1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CRI: Color-rendering index.

C. CU: Coefficient of utilization.

D. HID: High-intensity discharge.

E. LER: Luminaire efficacy rating.

F. Luminaire: Complete lighting fixture, including ballast housing if provided.

G. RCR: Room cavity ratio.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Ballast.
4. Energy-efficiency data.
5. Life, output, and energy-efficiency data for lamps.
6. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

    a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
    b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

1. Wiring Diagrams: Power and control wiring.

C. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Lighting fixtures.
2. Suspended ceiling components.
3. Structural members to which suspension systems for lighting fixtures will be attached.
4. 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.

5. Perimeter moldings.

D. Samples for Verification: Interior lighting fixtures designated for sample submission in Interior Lighting Fixture Schedule. Each sample shall include the following:

1. Lamps: Specified units installed.
2. Accessories: Cords and plugs.

E. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.

F. Qualification Data: For agencies providing photometric data for lighting fixtures.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

I. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

D. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

1.6 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.

1.7 WARRANTY

A. All LED light fixtures are to have warranty for 5 years – the warranty must be for parts and labor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified on the fixture schedule in the drawings.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

D. 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.

E. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

F. Plastic Diffusers, Covers, 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.

   a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
   b. UV stabilized.

2. Glass: Annealed crystal glass, unless otherwise indicated.

2.3 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.

2. Master/Remote Sign Configurations:

   a. Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in LED power supply for power connection to remote unit.
   b. Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.

2.4 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.

F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

2.5 REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES

(See Drawings)

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

C. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

D. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.

E. Adjust aimable lighting fixtures to provide required light intensities.

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 26 5100

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DIVISION 27 - COMMUNICATIONS

Not Used

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DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

Section 28 3111 Digital, Addressable Fire Alarm System

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SECTION 28 3111

DIGITAL, ADDRESSABLE FIRE ALARM SYSTEM

PART 1- GENERAL

1.1. DESCRIPTION

A. This section of the specification includes the furnishing, installation, and connection of a microprocessor controlled, analog addressable, intelligent fire alarm equipment required to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control panel (existing), auxiliary control devices, annunciators, power supplies, and wiring as shown on the drawings and specified herein.

B. The fire alarm system shall comply with requirements of NFPA Standard No. 72 for protected premises signaling systems except as modified and supplemented by this specification. The system field wiring shall be supervised either electrically or by software-directed polling of field devices.

C. The FACP and peripheral devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof).

1.2. SCOPE

A. A new intelligent reporting, microprocessor controlled fire detection system shall be installed in accordance with the specifications and drawings.

B. The system shall be designed such that each signaling line circuit (SLC) shall be limited to only 80% of its total capacity is used during the initial installation.

C. All existing conduit and fire alarm equipment shall be removed.

D. Basic Performance:

1. Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D).

2. Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z).

3. Digitized electronic signals shall employ check digits or multiple polling.

4. A single ground fault or open circuit on the system Signaling Line Circuit shall Not cause system malfunction, loss of operating power or the ability to report an alarm.

5. Alarm signals arriving at the main FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.

E. BASIC SYSTEM FUNCTIONAL OPERATION

When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:

1. The system alarm LED on the FACP shall flash.

2. A local piezo electric signal in the control panel shall sound.

3. A backlit LCD display (Existing) on the FACP shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.

4. Printing on the FACP (Existing) and history storage equipment (existing) shall log the information associated each new fire alarm control panel condition, along with time and date of occurrence.

5. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

1.3. SUBMITTALS

A. General:

1. Two copies of all submittals shall be submitted to the Architect/Engineer for review.

2. All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality. Equivalent equipment (compatible UL Listed) from other manufacturers may be substituted for the specified equipment as long as the minimum standards are met.

3. All substitute equipment proposed as equal to the equipment specified herein, shall meet or exceed the following standards. For equipment other than that specified, the contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.

2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.

3. Show annunciator layout and main control panel module layout, configurations and terminations.

C. Manuals:

1. Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturers name(s) including technical data sheets.

2. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment.

3. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system.

4. Approvals will be based on complete submissions of manuals together with shop drawings.

D. Software Modifications

1. Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.

2. Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm system on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being made.

E. Certifications:

Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.

1.4. GUARANTY:

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid.

1.5. POST CONTRACT MAINTENANCE:

A. Complete maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative for a period of five (5) years after expiration of the guaranty.

B. As part of the submittal, include a quote for a maintenance contract to provide all maintenance, test, and repair described below. Include also a quote for unscheduled maintenance/repair, including hourly rates for technicians trained on this equipment, and response travel costs. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for a five (5) year period after the expiration of the guaranty.

C. Maintenance and testing shall be on a semiannual basis or as required by the local AHJ. A preventive maintenance schedule shall be provided which describes the protocol for preventive maintenance. The schedule shall include:

1. Systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, waterflow switches and all accessories of the fire alarm system.

2. Each circuit in the fire alarm system shall be tested semiannually.

3. Each smoke detector shall be tested in accordance with the requirements of NFPA 72.

1.6. POST CONTRACT EXPANSIONS:

A. The contractor shall provide parts and labor to expand the system specified, if so requested, for a period of five (5) years from the date of acceptance.

B. As part of the submittal include a quotation for all parts and material, and all installation and test labor as needed to increase the number of intelligent or addressable devices by ten percent (10%). This quotation shall include analog addressable smoke detectors, heat detectors, manual stations, monitor modules and control modules equal in number to one tenth of the number required to meet this specification (list actual quantity of each type).

C. Quotation shall include installation, final testing and labor to reprogram the system for this 10% expansion. If additional FACP hardware would be required, include the material and labor necessary to install this hardware.

D. Do not include cost of conduit or wire or the cost to install conduit or wire.

E. Submittals that do not include this estimate of post contract expansion cost will not be accepted.

1.7. APPLICABLE PUBLICATIONS:

The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only.

A. National Fire Protection Association (NFPA) - USA:

No. 70	National Electric Code (NEC)
No. 72	National Fire Alarm Code
No. 90A	Air Conditioning Systems
No. 92A	Smoke Control Systems
No. 92B	Smoke Management Systems in Malls, Atria, Large Areas
No. 101	Life Safety Code

B. Underwriters Laboratories Inc. (UL) - USA:

No. 50	Cabinets and Boxes
No. 268	Smoke Detectors for Fire Protective Signaling Systems
No. 864	Control Units for Fire Protective Signaling Systems
No. 268A	Smoke Detectors for Duct Applications.
No. 521	Heat Detectors for Fire Protective
No. 228	Door Closers-Holders for Fire Protective Signaling Systems.
No. 464	Audible Signaling Appliances.
No. 38	Manually Actuated Signaling Boxes.
No. 346	Waterflow Indicators for Fire Protective Signaling Systems.
No. 1481	Power supplies for Fire Protective Signaling Systems.
No. 1076	Control Units for Burglar Alarm Proprietary Protective Signaling Systems.
No. 1971	Visual Notification Appliances.

C. Local and State Building Codes.

D. All requirements of the Authority Having Jurisdiction (AHJ).

1.8. APPROVALS:

A. The system must have proper listing and/or approval from the following nationally recognized agencies:

UL Underwriters Laboratories Inc

B. Modular Labeling

The fire alarm control panel shall meet the modular listing requirements of Underwriters Laboratories Inc. To facilitate system changes and expansions, and to ensure that all subassemblies have the proper listing, each subassembly of the FACP shall carry the appropriate UL modular label. This includes all printed circuit board assemblies, power supplies, and enclosure parts.

PART 2.0 PRODUCTS

2.1. EQUIPMENT AND MATERIAL, GENERAL:

A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling (fire alarm) system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.

B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram for all specific system installation/termination/wiring data.

C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.2. CONDUIT AND WIRE:

A. Conduit:

1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.

2. Where possible, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
3. Cable must be separated from any open conductors of Power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, as per NEC Article 760-29.

4. Wiring for 24 volt control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.

5. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.

6. Conduit shall be 3/4 inch (19.1 mm) minimum.

B. Wire:

1. All fire alarm system wiring must be new.

2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for initiating device circuits and signaling line circuits, and 14 AWG (1.63 mm) for notification appliance circuits.

3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.

4. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).

5. The system shall permit the use of IDC and NAC wiring in the same conduit with the multiplex communication loop.

6. All field wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, removal of any internal modules, or any open circuits in the field wiring; a trouble signal will be activated until the system and its associated field wiring are restored to normal condition.

7. The Fire Alarm Control panel shall be capable of T-Tapping Class B (NFPA Style 4) Signaling Line Circuits. Systems which do not allow, have restrictions to, for example, the amount of T-Taps, length of T-Taps etc., are not acceptable.

C. Terminal Boxes, Junction Boxes and Cabinets:

All boxes and cabinets shall be UL listed for their use and purpose.

D. Initiating circuits shall be arranged to serve like categories (manual, smoke, waterflow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.

E. The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG (3.25 mm#). The control panel cabinet shall be grounded securely to either a cold water pipe or grounding rod.

2.3. MAIN FIRE ALARM CONTROL PANEL(Existing):

A. The main FACP (Existing) shall contain a microprocessor based Central Processing Unit (CPU). The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent detectors, addressable modules, local and remote operator terminals, printers, annunciators, and other system controlled devices.

1. Function (Existing): The main FACP shall perform the following functions:

a. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.

b. Supervise all initiating signaling and notification circuits throughout the facility by way of connection to monitor and control modules.

c. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed.

d. Visually and audibly annunciate any trouble, supervisory, security or alarm condition on operator's terminals, panel display, and annunciators.

1. When a fire alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

a. The system alarm LED shall flash.

b. A local piezo-electric audible device in the control panel shall sound a distinctive signal.

c. The 80-character backlit LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.

d. Printing and history storage equipment shall log and print the event information along with a time and date stamp.

e. All system outputs assigned via preprogrammed equations for a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

2. When a trouble condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

a. The system trouble LED shall flash.

b. A local piezo-electric audible device in the control panel shall sound a distinctive signal.

c. The 80-character backlit LCD display shall indicate all information associated with the trouble condition, including the type of trouble point and its location within the protected premises.

d. Printing and history storage equipment shall log and print the event information along with a time and date stamp.

e. All system outputs assigned via preprogrammed equations for a particular point in trouble shall be executed, and the associated system outputs (trouble notification appliances and/or relays) shall be activated.

3. When a supervisory condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

a. The system trouble LED shall flash (Existing).

b. A local piezo-electric audible device in the control panel shall sound a distinctive signal.

c. The 80-character backlit LCD display shall indicate all information associated with the supervisory condition, including the type of trouble point and its location within the protected premises.

d. Printing and history storage equipment shall log and print the event information along with a time and date stamp.

e. All system outputs assigned via preprogrammed equations for a particular point in trouble shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.

B. System Capacity and General Operation (Existing)

1. The control panel shall be capable of expansion by 198 analog/addressable devices for a maximum system capacity of 1980 points. The system shall be capable of 2048 annunciation points per system regardless of the number of addressable devices.

2. The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit 80 character liquid crystal display, individual, color coded system status LEDs, and an alphanumeric keypad for the field programming and control of the fire alarm system.

3. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel.

4. The FACP (Existing) shall be able to provide the following features:

Block Acknowledge for Trouble Conditions
Rate Charger Control
Control-By-Time (Delay, Pulse, time of day, etc.)
Automatic Day/Night Sensitivity Adjust (high/low)
Device Blink Control (turn of detector LED strobe)
Environmental Drift Compensation (Selectable ON/OFF)
Smoke Detector Pre-alarm Indication at Control Panel
NFPA 72 Smoke Detector Sensitivity Test
System Status Reports
Alarm Verification, by device, with tally
Multiple Printer Interface
Multiple CRT Display Interface
Non-Fire Alarm Module Reporting
Automatic NFPA 72 Detector Test
Programmable Trouble Reminder
Upload/Download System Database to PC Computer
One-Man Walk Test
Smoke Detector Maintenance Alert
Security Monitor Points
Alpha-numeric Pager Interface
On-line or Off-line programming

C. Central Processing Unit (Existing)

1. The Central Processing Unit shall communicate with, monitor, and control all other modules within the control panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the system display by the Central Processing Unit.

2. The Central Processing Unit shall contain and execute all control-by-event (including ANDing, ORing, NOTing, CROSSZONEing) programs for specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure.

3. The Central Processing Unit shall also provide a real-time clock for time annotation of all system events. The time-of-day and date shall not be lost if system primary and secondary power supplies fail.

4. The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.

5. The CPU and associated equipment are to be protected so that they will not be affected by voltage surges or line transients consistent with UL864 standards.

6. Each peripheral device connected to the CPU shall be continuously scanned for proper operation. Data transmissions between the CPU and peripheral devices shall be reliable and error free. The transmission scheme used shall employ dual transmission or other equivalent error checking techniques.

D. Display (Existing)

1. The system display shall provide all the controls and indicators used by the system operator and may also be used to program all system operational parameters.

2. The display assembly shall contain, and display as required, custom alphanumeric labels for all intelligent detectors, addressable modules, and software zones.

3. The system display shall provide an 80-character back-lit alphanumeric Liquid Crystal Display (LCD). It shall also provide five Light-Emitting-Diodes (LEDs), that indicate the status of the following system parameters: AC POWER, SYSTEM ALARM, SYSTEM TROUBLE, DISPLAY TROUBLE, and SIGNAL SILENCE.

4. The system display shall provide a 25-key touch key-pad with control capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be accessible through the display interface assembly to prevent unauthorized system control or programming.

5. The system display shall include the following operator control switches:

SIGNAL SILENCE, LAMP TEST, RESET, SYSTEM TEST, and ACKNOWLEDGE.

E. Signaling Line Circuit (SLC) Interface Board

1. The SLC board shall monitor and control a minimum of 198 intelligent addressable devices. This includes 99 intelligent detectors (Ionization, Photoelectric, or Thermal) and 99 monitor or control modules.

2. The SLC interface board shall contain its own microprocessor and shall be capable of operating in a local/degrade mode (any addressable device input shall be capable of

activating any or all addressable device outputs) in the unlikely event of a failure in the main CPU.

3. The SLC interface board shall not require any jumper cuts or address switch settings to initialize operations.

4. The SLC interface board shall provide power and communicate with all intelligent addressable detectors and modules on a single pair of wires. This SLC Loop shall be capable of operating as a NFPA Style 6 (Class A) circuit.

5. The SLC interface board shall be able to drive an NFPA Style 4 twisted shielded circuit up to 12,500 feet in length. The SLC Interface shall also be capable of driving an NFPA Style 4, no twist, no shield circuit up to 3,000 feet in length. In addition, SLC wiring shall meet the listing requirements for it to exit the building or structure. "T"-tapping shall be allowed in either case.

6. The SLC interface board shall receive analog information from all intelligent detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for that particular device. The SLC interface board software shall include software to automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may also be used for automatic detector testing and the automatic determination of detector maintenance requirements.

F. Serial Interface Board (SIB) (Existing)

1. The Serial Interface Board shall provide an EIA-232 interfaces between the fire alarm control panel and the UL Listed Electronic Data Processing (EDP) peripherals.

2. The SIB shall allow the use of multiple printers, CRT monitors, and other peripherals connected to the EIA-232 ports.

3. The Serial Interface Board shall provide one EIA-485 port for the serial connection to annunciation and control subsystem components.

4. The SIB shall have LEDs that will show that it is in regular communication with annunciators or other EIA-485 connected peripheral devices.

5. EIA-232 serial output circuits shall be optically isolated to assure protection from earth ground.

6. The FACP will send packets of 80 ASCII characters followed by a carriage return (ODH) and a line feed (OAH). The external monitoring computer shall recognize certain combinations of characters in certain locations within the 80 character string in order to interpolate the status of the FACP.

G. Enclosures (Existing):

1. The control panels shall be housed in a UL listed cabinet suitable for surface or semi-flush mounting. Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
2. The back box and door shall be constructed of 0.060 steel with provisions for electrical conduit connections into the sides and top.

3. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be hinged on either the right or left side (field selectable).

4. The control unit shall be modular in structure for ease of installation, maintenance, and future expansion.

H. Power Supply:

1. The Main Power Supply shall operate on 120/240 VAC, 50/60 Hz, and shall provide all necessary power for the FACP.

2. It shall provide 3.0 amps of usable notification appliance power, using a switching 24 VDC regulator.

3. It shall be expandable, for additional notification appliance power, in 3.0 ampere increments.

4. It shall provide a battery charger for 24 hours of standby using dual-rate charging techniques for fast battery recharge. It shall charge up to 55 Amp Hour batteries within a 48 hour period.

5. It shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.

6. It shall be power-limited per 1995 UL864 requirements.

7. It shall provide meters to indicate battery voltage and charging current.

8. The power supply shall be capable of charging NICAD batteries up to 32 Amp Hours.

I. Universal Digital Alarm Communicator Transmitter (UDACT). The UDACT is an interface for communicating digital information between a fire alarm control panel and a UL-Listed central station.

1. The UDACT shall be compact in size, mounting in a standard module position of the fire alarm control cabinet. Optionally, the UDACT shall have the ability for remote mounting, up to 6,000 feet (1828.8 m) from the fire alarm control panel. The wire connections between the UDACT and the control panel shall be supervised with one pair for power and one pair for multiplexed communication of overall system status. Systems that utilize relay contact closures are not acceptable.

2. The UDACT shall include connections for dual telephone lines (with voltage detect), per UL/NFPA/FCC requirements. It shall include the ability for split reporting of panel events up to three different telephone numbers.

3. The UDACT shall be completely field programmable from a built-in keypad and 4 character red, seven segment display.

4. The UDACT shall be capable of transmitting events in at least 15 different formats. This ensures compatibility with existing and future transmission formats.

5. Communication shall include vital system status such as:

- Independent Zone (Alarm, trouble, non-alarm, supervisory)
- Independent Addressable Device Status
- AC (Mains) Power Loss
- Low Battery and Earth Fault
- System Off Normal
- 12 and 24 Hour Test Signal

- Abnormal Test Signal (per UL requirements)
- EIA-485 Communications Failure
- Phone Line Failure

6. The UDACT shall support independent zone/point reporting when used in the Contact ID format. In this format the UDACT shall support transmission of up to 2,040 points. This enables the central station to have exact details concerning the origin of the fire or response emergency.

J. Auxiliary Field Power Supply - Addressable

1. The auxiliary addressable power supply is a remote 24 VDC power supply used to power Notification Devices and field devices that require regulated 24VDC power. The power supply shall also include and charge backup batteries.

2. The addressable power supply for the fire alarm system shall provide up a minimum of 6.0 amps of 24 volt DC regulated power for Notification Appliance Circuit (NAC) power or 5 amps of 24 volt DC general power. The power supply shall have an additional .5 amp of 24 VDC auxiliary power for use within the same cabinet as the power supply. It shall include an integral charger designed to charge 7.0 - 25.0 amp hour batteries.

3. The addressable power supply shall provide four individually addressable Notification Appliance Circuits that may be configured as two Class "A" and two Class "B" or four Class "B" only circuits. All circuits shall be power-limited per UL 864 requirements.

4. The addressable power supply shall provide built-in synchronization for certain Notification Appliances on each circuit without the need for additional synchronization modules. The power supply's output circuits shall be individually selected for synchronization. A single addressable power supply shall be capable of supporting both synchronized and non-synchronized Notification Devices at the same time.

5. The addressable power supply shall operate on 120 or 240 VAC, 50/60 Hz.

6. The interface to the power supply from the Fire Alarm Control Panel (FACP) shall be via the Signaling Line Circuit (SLC) or other multiplexed means Power supplies that do not use an intelligent interface are not suitable substitutes. The required wiring from the FACP to the addressable power supply shall be a single unshielded twisted pair wire. Data on the SLC shall be transmitted between 24 VDC, 5 VDC and 0 VDC at approximately 3.33k baud.

7. The addressable power supply shall supervise for battery charging failure, AC power loss, power brownout, battery failure, NAC loss, and optional ground fault detection. In the event of a trouble condition, the addressable power supply shall report the incident and the applicable address to the FACP via the SLC.

8. The addressable power supply shall have an AC Power Loss Delay option. If this option is utilized and the addressable power supply experiences an AC power loss, reporting of the incident to the FACP will be delayed. A delay time of eight or sixteen hours shall be Dip-switch selected.

9. The addressable power supply shall have an option for Canadian Trouble Reporting and this option shall be Dip-switch selectable.

10. The addressable power supply mounts in either the FACP backbox or it's own dedicated surface mounted backbox with cover.

11. Each of the power supply's four output circuits shall be DIP-switch selected for Notification Appliance Circuit or General Purpose 24 VDC power. Any output circuit shall be able to provide up to 2.5 amps of 24 VDC power.

12. The addressable power supply's output circuits shall be individually supervised when they are selected to be either a Notification Appliance Circuit when wired Class "A" or by the use of and end-of-line resistor. When the power supply's output circuit is selected as General 24VDC power, the circuit shall be individually supervised when an end-of-line relay is used.

13. When selected for Notification Appliance Circuits, the output circuits shall be individually DIP-switch selectable for Steady, March Time, Dual Stage or Temporal.

14. When selected as a Notification Appliance Circuit, the output circuits of the addressable power supply shall have the option to be coded by the use of a universal zone coder.

15. The addressable power supply shall interface and synchronize with other power supplies of the same type. The required wiring to interface multiple addressable power supplies shall be a single unshielded, twisted pair wire.

16. An individual or multiple interfaced addressable power supplies shall have the option to use an external charger for battery charging. Interfaced power supplies shall have the option to share backup battery power.

K. System Circuit Supervision:

1. The FACP shall supervise all circuits to intelligent devices, annunciators and conventional peripherals and annunciate loss of communications with these devices. The CPU shall continuously scan above devices for proper system operation and upon loss of response from a device shall sound an audible trouble, indicate that device or devices are not responding and print the information in the history buffer and on a printer.

2. Sprinkler system valves, standpipe control valves, PIV and main gate valves shall be supervised for off-normal position.

L. Field Wiring Terminal Blocks:

For ease of service all wiring terminal blocks shall be the plug-in/removable type and be capable of terminating up to 12 AWG (3.25 mm#) wire. Terminal blocks that are permanently fixed to the PC board are not acceptable.

M. Operators Terminal: Provide the following standard operator full-system programming functions:

1. Acknowledge (ACK/STEP) Switch:

a. Activation of the control panel acknowledge switch in response to a single new alarm and/or trouble condition shall silence the local panel piezo electric signal and change the system alarm or trouble LED from flashing mode to steady-ON mode. If additional alarm or trouble conditions exist or are detected and reported in the system, depression of this switch shall acknowledge and/or advance the 80-character LCD display to the next alarm or trouble condition.

b. A common Acknowledge switch for all events shall be used for ease of operation. Systems that utilize multiple Acknowledge switches depending on the event are unacceptable due the confusion which could materialize during an emergency situation.

c. Depression of the acknowledge switch shall silence all remote annunciator piezo sounders.

2. Signal Silence Switch:

Activation of the signal silence switch shall cause all notification appliances and relays which are programmed to do so to return to the normal condition after an alarm condition. The selection of notification circuits and relays that are silenceable by this switch shall be fully field programmable within the confines of all applicable standards.

3. System Reset Switch:

Activation of the system reset switch shall cause all electronically-latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition.

If the alarm condition(s) still exist, or if they reoccur in the system after system reset switch activation, the system shall then resound the alarm conditions.

4. System Test Switch:

Activation of the system test switch shall initiate an automatic test of all Analog/Addressable detectors in the system. The system test shall activate the electronics in each analog/addressable sensor, simulating an alarm condition and causing the transmission of the alarm condition from that sensor to the fire alarm control panel. The fire alarm control panel shall interpret the data from each sensor installed in the system. A report summarizing the results of this test shall be displayed automatically on the control panel's liquid crystal display, CRT and printer. This report shall display the number of detectors tested per SLC/loop, the total number tested in the system, any detector that failed, or an all "Tested OK" message. Also included shall be a time/date stamp of when the test was performed.

5. Lamp Test Switch:

Activation of the lamp test switch shall sequentially turn on all LED indicators, liquid crystal display and local piezo-electric signal, and then automatically return the fire alarm control panel to the previous condition.

N. Remote Transmissions:

1. Provide local energy or polarity reversal or trip circuits as required.

2. The system shall be capable of operating a polarity reversal or local energy or fire alarm transmitter for automatically transmitting fire information to the fire department.

3. Provide capability and equipment for transmission of zone alarm and trouble signals to remote operator's terminals, system printers and annunciators.

4. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

O. System Expansion: Design the main FACP and transponders so that the system can be expanded in the future (to include the addition of twenty percent more circuits or zones) without disruption or replacement of the existing control panel. This shall include hardware capacity, software capacity and cabinet space.

P. Field Programming

1. The system shall be programmable, configurable and expandable in the field without the need for special tools, laptop computers, or other electronic interface equipment. There shall be no firmware changes required to field modify the system time, point information, equations, or annunciator programming/information.

2. It shall be possible to program through the standard FACP keyboard all system functions.
3. All field defined programs shall be stored in non-volatile memory.

4. Two levels of password protection shall be provided in addition to a key-lock cabinet. One level shall be used for status level changes such as point/zone disable or manual on/off commands(Building Manager). A second (higher-level) shall be used for actual change of the life safety program (installer). These passwords shall be five (5) digits at a minimum. Upon entry of an invalid password for the third time within a one minute time period an encrypted number shall be displayed. This number can be used as a reference for determining a forgotten password.

5. The system programming shall be "backed" up on a 3.5" floppy diskette utilizing an upload/download program. This system back-up disk shall be completed and given in duplicate to the building owner and/or operator upon completion of the final inspection. The program that performs this function shall be "non-proprietary", in that, it shall be possible to forward it to the building owner/operator upon his or her request.

Q. The installer's field programming and hardware shall be functionally tested on a computer against known parameters/norms which are established by the FACP manufacturer. A software program shall test Input-to-Output correlations, device Type ID associations, point associations, time equations, etc. This test shall be performed on an IBM-compatible PC with a verification software package. A report shall be generated of the test results and two copies turned in to the engineer(s) on record.

R. It shall be the responsibility of the equipment supplier /installer to ensure that all equipment supplied will fit in locations designated on plans and in the specifications.

S. Specific System Operations

1. Smoke Detector Sensitivity Adjust: Means shall be provided for adjusting the sensitivity of any or all analog intelligent smoke detectors in the system from the system keypad or from the keyboard of the video terminal. Sensitivity range shall be within the allowed UL window.

2. Alarm Verification: Each of the Intelligent Addressable Smoke Detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification function shall be programmable from 5 to 50 seconds and each detector shall be able to be selected for verification during the field programming of the system or anytime after system turn-on. Alarm verification shall not require any additional hardware to be added to the control panel. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.

3. System Point Operations:

a. Any addressable device in the system shall have the capability to be enabled or disabled through the system keypad or video terminal.

b. System output points shall be capable of being turned on or off from the system keypad or the video terminal.

4. Point Read: The system shall be able to display the following point status diagnostic functions without the need for peripheral equipment. Each point shall be annunciated for the parameters listed:

    a. Device Status.
    b. Device Type.
    c. Custom Device Label.
    d. Software Zone Label.
    e. Device Zone Assignments.
    f. Analog Detector Sensitivity.
    g. All Program Parameters.

5. System Status Reports: Upon command from an operator of the system, a status report will be generated and printed, listing all system statuses:

6. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 400 system events. Each of these events will be stored, with time and date stamp, until an operator requests that the contents be either displayed or printed. The contents of the history buffer may be manually reviewed, one event at a time, and the actual number of activations may also be displayed and or printed.

    The history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable.

7. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent system detector and shall analyze the detector responses over a period of time.

    If any intelligent detector in the system responds with a reading that is below or above normal limits, then the system will enter the trouble mode, and the particular Intelligent Detector will be annunciated on the system display, and printed on the optional system printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.

8. The system shall include the ability (programmable) to indicate a "pre-alarm" condition. This will be used to alert maintenance personal when a detector is at 80% of its alarm threshold in a 60 second period.

2.4. SYSTEM COMPONENTS:

A. Voice Evacuation Panel

B. Speakers:

1. Speakers shall operate on 24 VDC nominal.

2. Volume for the speakers shall be field adjustable with an output sound level of at least 90 dBA measured at 10 feet from the device.

3. Shall be flush or surface mounted as show on plans.

C. Strobe lights shall meet the requirements of the ADA, UL Standard 1971 and shall meet the following criteria:

1. The maximum pulse duration shall be 2/10 of one second.

2. Strobe intensity shall meet the requirements of UL 1971.

3. The flash rate shall meet the requirements of UL 1971.

D. Audible/Visual Combination Devices:

1. Shall meet the applicable requirements of Section A listed above for audibility.

2. Shall meet the requirements of Section B listed above for visibility.

E. Addressable Devices - General

1. Addressable devices shall provide an address-setting means using rotary decimal switches.

2. Addressable devices shall use simple to install and maintain decade (numbered 0 to 9) type address switches. Devices which use a binary address or special tools for setting the device address, such as a dip switch are not an allowable substitute.

3. Detectors shall be Analog and Addressable, and shall connect to the fire alarm control panel's Signaling Line Circuits.

4. Addressable smoke and thermal detectors shall provide dual (2)status LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. If required, the flashing mode operation of the detector LEDs can be programmed off via the fire control panel program.

5. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. Sensitivity can be automatically adjusted by the panel on a time-of-day basis.

6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.

7. The detectors shall be ceiling-mount and shall include a separate twist-lock base which includes a tamper proof feature.
8. The following bases and auxiliary functions shall be available :

    a. Sounder base rated at 85 DBA minimum.

    b. Form-C Relay base rated 30VDC, 2.0A

    c. Isolator base

9. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.

10. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).

F. Addressable Pull Box (manual station)

1. Addressable pull boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.

2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.

3. Manual stations shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger.

G. Intelligent Photoelectric Smoke Detector

1. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

H. Intelligent Thermal Detectors

1. Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.

I. Intelligent Duct Smoke Detector

1. The in-duct smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel.

2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.

J. Addressable Dry Contact Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs.

2. The monitor module shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box.

3. The IDC zone shall be suitable for Style D or Style B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

4. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch (70 mm) x 1-1/4 inch (31.7 mm) x 1/2 inch (12.7 mm). This version need not include Style D or an LED.

K. Addressable Control Module

1. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification

appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contract relay.

2. The control module shall mount in a standard 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box, or to a surface mounted backbox.

3. The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation, or as a dry contact (Form-C) relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

4. Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised, UL listed remote power supply.

5. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.

2.5. BATTERIES AND EXTERNAL CHARGER:

A. Battery:

1. Shall be a 12 volt, Gell-Cell type.
2. Battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.

3. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks refilling, spills and leakage shall not be required.

B. External Battery Charger:

1. Shall be completely automatic, with constant potential charger maintaining the battery fully charged under all service conditions. Charger shall operate from a 120/208-volt 50/60 hertz source.

2. Shall be rated for fully charging a completely discharged battery within 48 hours while simultaneously supplying any loads connected to the battery.

3. Shall have protection to prevent discharge through the charger.

4. Shall have protection for overloads and short circuits on both AC and DC sides.

PART 3.0 - EXECUTION

3.1. INSTALLATION:

A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

3.2. TYPICAL OPERATION:

A. Actuation of any manual station, smoke detector heat detector or water flow switch shall cause the following operations to occur unless otherwise specified:

1. Activate all programmed notification circuits until silenced.

2. Actuate all strobe units until the panel is reset.

3. Annunciate the active initiating devices and zones.

4. Release all magnetic door holders to doors to adjacent zones on the floor from that the alarm was initiated.

5. Return all elevators to the primary or alternate floor of egress.
6. A smoke detector in any elevator lobby shall, in addition to the above functions, return all elevators to the primary or alternate floor of egress.

7. Smoke detectors in the elevator machine room or top of hoistway shall return all elevators in to the primary or alternate floor. Smoke detectors or heat detectors installed to shut down elevator power shall do so in accordance with ANSI A17.1 requirements and be coordinated with the electrical contractor.

8. Duct type smoke detectors shall, in addition to the above functions shut down the ventilation system or close associated control dampers as appropriate.

9. Activation of any sprinkler system low pressure switch, or valve tamper switch shall cause a system supervisory alarm indication.

3.3. TEST:

Provide the service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
   Perform 24 hour battery test. AC-power to be turned off at the end of 24 hours. Test the entire system notification devices for a minimum of 5 minutes. If failed, add additional batteries, power supplies, etc. as required.

2. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.

3. Verify activation of all flow switches.

4. Open initiating device circuits and verify that the trouble signal actuates.

5. Open signaling line circuits and verify that the trouble signal actuates.

6. Open and short notification appliance circuits and verify that trouble signal actuates.

7. Ground initiating device circuits and verify response of trouble signals.

8. Ground signaling line circuits and verify response of trouble signals.

9. Ground notification appliance circuits and verify response of trouble signals.

10. Check presence and audibility of tone at all alarm notification devices.

11. Check installation, supervision, and operation of all intelligent smoke detectors during a walk test.

12. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

13. When the system is equipped with optional features, the manufacturer's manual should be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.4. FINAL INSPECTION:

At the final inspection a factory trained representative of the manufacturer of the major equipment shall demonstrate that the systems function properly in every respect.

3.5. INSTRUCTION:

A. Provide instruction as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

B. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

C. Refer to specification section 17000 for project commissioning requirements.

3.6 The equipment and systems referenced in this section are to be commissioned per Section 01810 – Commissioning General Requirements and Section 16995 – Commissioning: Mechanical Systems. The contractor, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 28 3111

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DIVISION 31 thru 48

Not Used