MSA SPORT

a division of MSA Architects

PROJECT MANUAL

Xavier University
Cintas Center - Strength & Conditioning Addition

Project Location
Xavier University
Cintas Center
1624 Herald Avenue
Cincinnati, OH 45207

PROJECT MANUAL AND SPECIFICIATIONS
September 4, 2015

MSA Project Number 15130.20

BID DOCUMENTS

Civil Engineer
Kleingers Group
6305 Centre Park Drive
West Chester, OH 45069

Structural Engineer
Schaefer
10411 Medallion Drive
Cincinnati, OH 45241

MEP&T Engineer
Motz Engineering
300 W. Fourth Street
Cincinnati, OH 45202

CINCINNATI
316 West Fourth Street
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Cincinnati, Ohio 45202
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SECTION 000110 - PROJECT MANUAL INDEX

Division 0 – Procurement and Contracting Requirements

Division 1 – General Requirements

Division 2 – Existing Conditions

Division 3 – Concrete

Division 4 – Masonry

Division 5 – Metals

Division 6 – Wood, Plastics, Composites

Division 7 – Thermal And Moisture Protection

Division 8 – Openings

Division 9 – Finishes

Division 10 – Specialties

Division 12 – Furnishings

Division 21 – Fire Protection Work

Division 22 – Plumbing Work

Division 23 – Heating, Ventilation, and Air Conditioning Work

Division 25 – Technology

Division 26 – Electric Work

END OF PROJECT MANUAL INDEX

SECTION 000020 - REQUEST FOR BID

Date:	September 4, 2015
Project:	Xavier University Cintas Center – Strength & Conditioning Addition 1624 Herald Avenue Cincinnati, Ohio 45207
Owner:	Xavier University 3800 Victory Parkway Cincinnati, Ohio 45207 Phone: 513-745-4303 Contact: Jim Bergen, Project Manager Email: bergen@xavier.edu
Architect:	MSA Architects 316 West Fourth Street Cincinnati, Ohio 45202 Phone: 513-241-5666 Contact: Chris Bujnak, AIA Email: cbujnak@msaarch.com

Sealed bids will be received by **Jim Bergen, XU Project Manager at 3637 Woodburn Avenue, Cincinnati, OH 45207, by 2:00 pm local time, on xxxxx**, for the Cintas Center Strength & Conditioning Addition project in accordance with the Drawings and Specifications prepared by MSA Architects. Submit all questions to Chris Bujnak by e-mail (cbujnak@msaarch.com).

The Work consists of the construction of a 4,000SF building addition for new strength and conditioning training space on the north side of the exiting Cintas Center. The structural frame type and exterior concrete panels of the addition will match that of the exiting construction. Also included is the renovation of approximately 900 SF of interior space immediately adjacent to the building addition. The project will also include all necessary site work and MEP&T work as outlined within the bid documents.

One set of electronic bidding documents shall be provided to the bidding Contractors. Additional documents may be obtained by contacting Chris Bujnak, MSA Architects.

There will be no pre-bid meeting for this project. Bidders wishing to make visits to the site shall confirm scheduling by contacting Mr. Jim Bergen by phone (513-745-4303) or e-mail (bergen@xavier.edu).

Submit your bid on the Bid Form provided.

Your bid will be required to be submitted under a condition of irrevocability for a period of sixty (60) days after submission.

The Owner reserves the right to accept or reject any or all offers.

END OF SECTION 000020

SECTION 001000 - INSTRUCTIONS TO BIDDERS

PART 1 - SUMMARY

1.1 DOCUMENT INCLUDES

A. Invitation.

1. Bid Submission
2. Work Identified in the Contract Documents
3. Contract Time

B. Bid Documents and Contract Documents

1. Definitions
2. Contract Documents Identification
3. Availability
4. Examination
5. Queries/Addenda
6. Product/System Substitutions

C. Site Assessment

1. Site Examination
2. Pre-bid Conference

D. Qualifications

1. Subcontractors/Suppliers/Others

E. Bid Submission

1. Submission Procedure
2. Bid Ineligibility

F. Bid Enclosures/Requirements

1. Performance Assurance
2. Bid Form Requirements
3. Fees for Changes in the Work.
4. Bid Form Signature.

G. Offer Acceptance/Rejection.

1. Duration of Offer.
2. Acceptance of Offer.

1.2 RELATED DOCUMENTS

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

1. Section 000020 - Request For Bid.
2. Section 001020 - Bid Form.

PART 2 - INVITATION

2.1 BID SUBMISSION

A. Bids are due on the date, time, and place as outlined in Section 000020, Request For Bid.

B. Offers submitted after the above time will be returned to the Bidder unopened.

C. Offers will be opened privately immediately after the time for receipt of Bids.

D. Amendments to the submitted offer will be permitted if received in writing prior to Bid closing and if endorsed by the same party or parties who signed and sealed the offer.

2.2 WORK IDENTIFIED IN THE CONTRACT DOCUMENTS

A. The Work consists of replacement of the telescoping lower bowl seating within the Cintas Center. The replacement will include removal of the existing retractable seating systems and installation of both new seats and retractable infrastructure. In addition to the folding seats, the project will also include a modified location for the floor-level access tunnel, along with bleacher (bench) style seating in the student section (refer to attached concept drawing).

B. Location: At address indicated in Section 000020, Request For Bid.

2.3 CONTRACT TIME

A. Project completion shall be as outlined in Section 011000 Summary.

PART 3 - BID DOCUMENTS AND CONTRACT DOCUMENTS

3.1 CONTRACTS

A. Contract Documents forming the Construction Contract to include but not limited to:

1. Request For Bid.
2. Instructions to Bidders.
3. Bid Form.
4. Form of Agreement Between Owner and Contractor.
5. General Conditions of the Contract for Construction, AIA A201-2007.
6. Supplemental Conditions of the Contract for Construction.
7. Contractor Liability Insurance
8. Project Specifications.
9. Project Drawings.

3.2 DEFINITIONS

A. Bid Documents: Contract Documents supplemented with Request For Bids, Instructions to Bidders, Bid Form identified herein.

B. Contract Documents: Defined in AIA A201 Article 1 including issued Addenda.

C. Bid, Offer, or Bidding: Act of submitting an offer under seal.

D. Bid Price: Monetary sum identified by the Bidder in the Bid Form.

3.3 CONTRACT DOCUMENTS IDENTIFICATION

A. The Contract Documents are identified as Project Number 15130.20 as prepared by the Architect, MSA Architects located at 316 West Fourth Street, Sixth Floor, Cincinnati, Ohio 45202.

3.4 AVAILABILITY

A. Bid Documents are available as indicated in Section 000020, Request For Bid.

B. Bid Documents are made available only for the purpose of obtaining offers for this project. Their use does not grant a license for other purposes.

3.5 EXAMINATION

A. Upon receipt of Bid Documents verify that documents are complete. Notify Architect should the documents be incomplete.

B. Immediately notify the Architect upon finding discrepancies or omissions in the Bid Documents.

3.6 QUERIES/ADDENDA

A. Addenda may be issued during the Bidding period. All Addenda become part of the Contract Documents. Include resultant costs in the Bid Price.

B. Oral (not in writing) answers are not binding on any party.

C. Clarifications requested by Bidders must be in writing not less than 4 working days before date set for receipt of Bids. The reply will be in the form of an Addendum, a copy of which will be forwarded to known recipients.

D. Queries are to be addressed to Chris Bujnak (cbujnak@msaarch.com) at MSA Architects.

E. Should it be impossible to request clarification and resolve a discrepancy in writing in the time frame set forth, the bidder shall bid the work the more expensive way.

3.7 PRODUCT/SYSTEM SUBSTITUTIONS

A. Where the Bid Documents stipulate a particular Product, substitutions will be considered by the Architect up to 4 business days before receipt of Bids.

B. Where substitutions are not approved in advance by the Architect, Bidders are encouraged to submit cost-saving substitutions with the bid, but must comply with the requirements of this Section and quote as a voluntary deduct from the base bid only.

C. The submission shall provide sufficient information to determine acceptability of such products.

D. When a request to substitute a Product is made, the Architect may approve the substitution and will issue an Addendum to known Bidders.

E. In submission of substitutions to products specified, Bidders shall include in their Bid any changes required in the Work and changes to Contract Time and Contract Sum/Price to accommodate such substitutions. A later claim by the Bidder for an addition to the Contract Time or Contract Sum/Price because of changes in Work necessitated by use of substitutions shall not be considered.

PART 4 - SITE ASSESSMENT

4.1 SITE EXAMINATION

A. There will be a pre-bid meeting held on site for this project on **xxxx**. Bidders wishing to make additional visits to the site shall confirm scheduling by contacting Mr. Jim Bergen by phone (513-745-4303) or e-mail (bergen@xavier.edu).

PART 5 - QUALIFICATIONS

5.1 SUBCONTRACTORS/SUPPLIERS/OTHERS

A. The Owner reserves the right to reject a proposed Subcontractor for reasonable cause.

B. Refer to AIA Article 5 of General Conditions.

PART 5 - BID SUBMISSION

5.1 SUBMISSION PROCEDURE

A. Bidders shall be solely responsible for the delivery of their Bids in the manner and time prescribed.

B. Submit one copy of the executed offer on the Bid Form provided, signed and sealed in a closed opaque envelope, clearly identified with Bidder's name, project name and Owner's name on the outside.

5.2 BID INELIGIBILITY

A. Bids that are unsigned, improperly signed or sealed, conditional, illegible, obscure, contain arithmetical errors, erasures, alterations, or irregularities of any kind, may at the discretion of the Owner, be declared unacceptable.

B. Bid Forms and enclosures which are incomplete or improperly prepared may, at the discretion of the Owner, be declared unacceptable.

C. Bids are by invitation only from selected Bidders. Bids from unsolicited Bidders will be returned.

D. Bids that are not based upon the issued drawings and specifications or approved substitutions may, at the discretion of the Owner, be declared unacceptable.

PART 6 - BID ENCLOSURES/REQUIREMENTS

6.1 TAX EXEMPTION

A. The Owner is exempt from state sales tax. Contractors shall provide Exemption Certificates to the Owner for signature if required.

6.2 PERFORMANCE ASSURANCE

A. Bidder shall furnish a Bid Guaranty, as prescribed in Sections 153.54, 153.57, and 153.571 of the Ohio Revised Code, in the form of either: (1) a bond for the full amount of the bid in the form of the Bid Guaranty and Contract Bond included in the Bid Documents; or (2) a certified check, cashier's check, or irrevocable letter of credit in an amount equal to 10% of the bid. Bid amount shall be the total of all sums bid, including all add alternatives, but excluding all deduct alternatives. NOTE: AIA Bid Bond forms are not acceptable.

B. The successful Bidder, who, as a Bid Guaranty, submits a certified check, cashier's check, or irrevocable letter of credit in an amount equal to 10% of the bid, shall furnish a Contract Bond in the form Contract Bond included in the Bid Documents in an amount equal to 100% of the Contract Sum. NOTE: AIA Bond forms are not acceptable.

6.3 BID FORM REQUIREMENTS

A. Complete all requested information in the Bid Form and submit additional documentation as required.

6.4 BID FORM SIGNATURE

A. The Bid Form shall be signed by the Bidder, as follows:

1. Sole Proprietorship: Signature of sole proprietor in the presence of a witness who will also sign. Insert the words "Sole Proprietor" under the signature.
2. Partnership: Signature of all partners in the presence of a witness who will also sign. Insert the word "Partner" under each signature.
3. Corporation: Signature of a duly authorized signing officer(s) in their normal signatures. Insert the officer's capacity in which the signing officer acts, under each signature. Affix the corporate seal. If the Bid is signed by officials other than the President and Secretary of the company, or the President/Secretary/Treasurer of the company, a copy of the by-law resolution of the Board of Directors authorizing them to do so, must also be submitted with the Bid Form in the Bid envelope.
4. Joint Venture: Each party of the joint venture shall execute the Bid Form under their respective seals in a manner appropriate to such party as described above, similar to the requirements of a Partnership.

PART 7 - OFFER ACCEPTANCE/REJECTION

7.1 DURATION OF OFFER

A. Bids shall remain open to acceptance and shall be irrevocable for a period of sixty (60) days after the Bid closing date.

7.2 ACCEPTANCE OF OFFER

A. The Owner reserves the right to accept or reject any or all offers.

A. After acceptance by the Owner, the Owner or the Architect on behalf of the Owner will issue to the successful Bidder a written Bid Acceptance.

END OF SECTION 001000

BID FORM

1.01 BID SUBMITTED BY:

_____

(Contractor)

DATED: _____

1.02 DELIVER TO: Jim Bergen, Project Manager
Xavier University
3637 Woodburn Avenue
Cincinnati, Ohio 45207

1.03 Having viewed the Drawings and read the Specifications for the Project entitled:

Cintas Center – Strength & Conditioning Addition

and having also received, read and taken into account the following Addenda:

Addendum No. _____, dated _____;

Addendum No. _____, dated _____;

Addendum No. _____, dated _____;

Addendum No. _____, dated _____;

and likewise having inspected the site and the conditions affecting and governing the Project and confirmed the location of the site utilities and all existing structures, the undersigned hereby proposes to furnish all materials and to perform all labor, as specified and described in the said Specifications and/or as shown on the said Drawings for all work necessary to complete the Project on a timely basis and in accordance with the Contract Documents regardless of whether expressly provided for in such Specifications and Drawings.

1.04 Before completing the Bid Form, the undersigned represents that it has carefully reviewed the Request For Bid, Instructions to Bidders, Bid Form, Owner-Contractor Agreement, General Conditions of the Contract (AIA A201-2007 edition), Supplemental Conditions, Project Drawings, Project Specifications, and the Project Schedule. Failure to comply with provisions of the Contract Documents may be cause for disqualification of the Bid.

1.05 BOND AND CONTRACT: If the undersigned is notified of bid acceptance, it agrees to furnish the required bond as indicated in Instructions to Bidders.

1.06 COMPLETION OF WORK: In submitting a bid, the undersigned agrees to execute the Owner-Contractor Agreement in the form included in the Contract Documents and to substantially complete its work as required by the Contract Documents.

1.07 The wording of the Bid Form shall be used throughout, without change, alteration, or addition. Any change may cause it to be rejected.

1.08 Bidder is cautioned to bid only on the “Brands” specified.

2.01 Bid:

All labor and material for the contracts listed below. Bidder is to fill in all blanks related to the Bid Package for which a bid is being submitted. If no bid is submitted for an item, leave the item blank or insert "NO BID" in the blank. For alternate items, indicate whether the amount stated is in addition to or a deletion from the base bid amount.

ITEM 1. BID PACKAGE 1: Strength & Conditioning Addition. The Work consists of the construction of a 4,000SF building addition for new strength and conditioning training space on the north side of the exiting Cintas Center. The structural frame type and exterior concrete panels of the addition will match that of the exiting construction. Also included is the renovation of approximately 900 SF of interior space immediately adjacent to the building addition. The project will also include all necessary site work and MEP&T work as outlined within the bid documents.

BASE BID
ALL LABOR AND MATERIAL, for the sum of $ _____

_____

(bid amount stated in words)

3.01 INSTRUCTIONS FOR SIGNING

1. The person signing for a sole proprietorship must be the sole proprietor or his authorized representative. The name of the sole proprietor must be shown below.
2. The person signing for a partnership must be a partner or his authorized representative.
3. The person signing for a corporation must be the president, vice president or other authorized representative; or he must show authority, by affidavit, to bind the corporation.
4. The person signing for some other legal entity must show his authority, by affidavit, to bind the legal entity.

4.01 BIDDER CERTIFICATIONS. The Bidder hereby acknowledges that the following representations in this bid are material and not mere recitals:

1. The Bidder has read and understands the Contract Documents and agrees to comply with all requirements of the Contract Documents, regardless of whether the Bidder has actual knowledge of the requirements and regardless of any statement or omission made by the Bidder which might indicate a contrary intention.
2. The Bidder represents that the bid contains the name of every person interested therein and is based upon the Standards specified by the Contract Documents.
3. The Bidder has visited the Project site, become familiar with local conditions and has correlated personal observations about the requirements of the Contract Documents. The Bidder has no outstanding questions regarding the interpretation or clarification of the Contract Documents.
4. The Bidder and each person signing on behalf of the Bidder certifies, and in the case of a bid by joint venture, each member thereof certifies as to such member's entity, under penalty of perjury, that to the best of the undersigned's knowledge and belief: (a) the Base Bid, any Unit Prices and any Alternate bid in the bid have been arrived at independently without collusion, consultation, communication or agreement, or for the purpose of restricting competition as to any matter relating to such Base Bid, Unit Prices or Alternate bid with any other Bidder; (b) unless otherwise required by law, the Base Bid, any Unit Prices and any Alternate bid in the bid have not been knowingly disclosed by the Bidder and will not knowingly be disclosed by the Bidder prior to the bid opening, directly or indirectly, to any other Bidder who would have any interest in the Base Bid, Unit Prices or Alternate bid; (c) no attempt has been made or will be made by the Bidder to induce any other Person to submit or not to submit a bid for the purpose of restricting competition; and (d) the statements made in the Bidder's Affidavit are true and correct, to the best of the Bidder's knowledge and information.
5. The Bidder will execute the form of Owner/Contractor Agreement in the form included with the Contract Documents, if a Contract is awarded on the basis of this bid, and if the Bidder does not execute the Contract Form for any reason, other than as authorized by law, the Bidder and the Bidder's Surety are liable to the Library as provided in the Instructions to Bidders.

6. The Bidder certifies that the upon the award of a Contract, the Contractor will make a good faith effort to ensure that all of the Contractor's employees, while working on the Project site, will not purchase, transfer, use or possess illegal drugs or alcohol or abuse prescription drugs in any way.
7. The Bidder agrees to furnish any information requested by the Architect or the Owner's authorized representative to evaluate that the Bidder is responsible and that the bid is responsive to the specifications.
8. The Bidder agrees to furnish the submittals required by the Instructions to Bidders for execution of the Owner/Contractor Agreement within 10 days of the date of the Notice of Intent to Award.
9. The Bidder certifies that it has no unresolved findings for recovery issued by the Auditor of State.

NOTE: The Bidder should review the Contract Documents and the site and conditions under which the Work will be performed so that he can give the acknowledgments contained above.

LEGAL NAME OF BIDDER: _____

BIDDER IS: _____
(sole proprietor, partnership, corporation or other legal entity)

NAME OF PERSON LEGALLY AUTHORIZED TO BIND BIDDER TO A CONTRACT:

_____
(print)

SIGNATURE: _____

TITLE: _____

ADDRESS: _____ PHONE: _____

_____ FAX: _____

EMAIL ADDRESS: _____

FEDERAL TAX ID NO. _____

DATE SIGNED _____

When the Bidder is a partnership or a joint venture, state name and address of each partner in the partnership or participant in the joint venture below:

_____	_____
_____	_____
Name	
	_____
	Address
_____	_____
_____	_____

Name	Address
_____	_____
_____	_____
Name	Address
_____	_____
_____	_____
Name	Address
_____	_____
_____	_____
Name	Address

XAVIER UNIVERSITY

Office of Physical Plant
3800 Victory Parkway
Cincinnati,Ohio 45207-5411

P 513-745-3151
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Supplemental Conditions of the Contract for Construction

The following supplements modify AIA Document A201–2007, General Conditions of the Contract for Construction. Where a portion of the General Conditions is modified or deleted by these Supplementary Conditions, the unaltered portions of the General Conditions shall remain in effect.

1. Delete Section 2.2.3 and substitute the following:
   § 2.2.3 If appropriate to the nature and type of project, the Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

2. Add the following Section 3.2.5 to Section 3.2:
   § 3.2.5 The Owner is entitled to reimbursement from the Contractor for amounts paid to the Architect for evaluating and responding to the Contractor's requests for information that are not prepared in accordance with the Contract Documents or where the requested information is available to the Contractor from a careful study and comparison of the Contract Documents, field conditions, other Owner-provided information, Contractor-prepared coordination drawings, or prior Project correspondence or documentation**.**

3. Delete Section 3.6 and substitute the following:
   § 3.6 TAXES
   The Owner is a tax exempt entity, thus the Contractor is not required to pay sales tax for material or services related to the Work. This does not relieve the Contractor from the responsibility to pay any other taxes for the Work that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

4. Add Section 4.2.2.1 to Section 4.2.2:
   § 4.2.2.1 The Owner is entitled to reimbursement from the Contractor for amounts paid to the Architect for site visits made necessary by the fault of the Contractor or by defects and deficiencies in the Work.

5. Add the following Section 9.3.1.3 to Section 9.3.1:
   § 9.3.1.3 Until Substantial Completion, the Owner shall pay 90% percent of the amount due the Contractor on account of progress payments.

6. Delete Section 9.3.3 and substitute the following:
   § 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information and belief, be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work. Contractor will comply with all Ohio Mechanics Lien Laws to protect Owner and will continuously post the Notice of Commencement on the Job Site and provide Owner copies with any Notice of Furnishing within three (3) days of receipt by Contractor.

7. Delete Sections 11.1.1 and 11.1.2 and substitute the following:
   § 11.1.1 The Contractor shall purchase from and maintain in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located such insurance as will protect the Contractor from claims set forth in Exhibit C.

   § 11.1.2 The insurance required by Section 11.1.1 shall be written for not less than limits of liability specified in Exhibit C, the Contract Documents or required by law, whichever coverage is greater.

Office of Physical Plant
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Cincinnati,Ohio 45207-5411

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Supplemental Conditions of the Contract for Construction

Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from the date of commencement of the Work until the date of final payment and termination of any coverage required to be maintained after final payment, and, with respect to the Contractor's completed operations coverage, until the expiration of the period for correction of Work or for such other period for maintenance of completed operations coverage as specified in the Contract Documents.

8. Delete Section 11.4.1.3 and substitute the following:
   § 11.4.1.3 If the property insurance requires deductibles or excludes or limits coverage for certain perils, the Owner shall pay costs not covered because of such deductibles, excluded perils or limited coverage.

9. Delete Section 15.4.4.2 and substitute the following:
   § 15.4.4.2 Limitation on Consolidation or Joinder. No arbitration shall include, by consolidation or joinder or in any other manner, parties other than the Owner, Contractor, a separate contractor as described herein and other persons substantially involved in a common question of fact or law whose presence is required if complete relief is to be accorded in arbitration. No person or entity other than the Owner, Contractor or a separate contractor as described herein shall be included as an original third party or additional third party to an arbitration whose interest or responsibility is insubstantial. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of a Claim not described therein or with a person or entity not named or described therein. The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

10. Add the following Sections 15.1.5.3 and 15.1.5.4 to Section 15.1.5:
    § 15.1.5.3 Time being of the essence, claims for increase in the Contract Time shall set forth in detail the circumstances that form the basis for the Claim, the date upon which each cause of delay began to affect the progress of the Work, the date upon which each cause of delay ceased to affect the progress of the Work and the number of days' increase in the Contract Time claimed as a consequence of each such cause of delay. The Contractor shall provide such supporting documentation as the Owner may require including, where appropriate, a revised construction schedule indicating all the activities affected by the circumstances forming the basis of the Claim.

    § 15.1.5.4 The Contractor shall not be entitled to a separate increase in the Contract Time for each one of the number of causes of delay which may have concurrent or interrelated effects on the progress of the Work, or for concurrent delays due to the fault of the Contractor.

11. Delete Section 15.3 **Mediation** in its entirety

Exhibit C

Xavier University

Contractor Liability Insurance

The Contractor shall obtain, pay for and keep in force, insurance for protection from claims under workers' compensation acts, claims for damages because of bodily injury, including personal injury, sickness disease or death of any of the Contractors employees or of any other person; claims for damages because of injury to or destruction of property including loss of use resulting there from, claims for damages because of bodily injury or death of any persons or property damage arising out of ownership maintenance or use of any motor vehicle, aircraft, or watercraft, and claims arising out of the performance of the contract and caused by the Contractor's negligence. Compliance by the Contractor with the insurance requirements set forth herein shall not relieve the Contractor from liability for amounts in excess of the limits of insurance.

Prior to commencement of the work, the Contractor shall deliver to Owner insurance certificates evidencing that the required insurance is in force with insurance companies satisfactory to Owner. The Contractor shall deliver to Owner upon request copies of the actual insurance policies. All certificates of insurance required hereunder shall specifically state the insurers promise that there shall be no material change in, or cancellation of, the policy or policies evidenced except upon 30 days prior written notice via certified mail to Owner and that 30 days prior to the renewal date, the Contractor shall furnish Owner with updated or replacement certificates of insurance that clearly evidence continuation of all coverage's in the same manner, limits and protection, as required Owner, Owner shall be included as additional insured's under all coverage's as required by this Contract and such additional insured status shall be specifically identified on the certificates of insurance.

Such insurance as required shall be kept in force by the Contractor continuously during the life of the Contract, and for a period of not less than 90 days the date of final completion, additionally, the completed operations insurance required hereunder shall be kept in force by the Contractor for a period of not less than five years after the date of final completion.

The types of insurance and minimum amount of limits, required hereunder are:

a. Workers' Compensation Insurance coverage: statutory requirements in the State of Ohio and any other applicable state.

b. Employers Liability Insurance with limits of not less than $2,000,000 to any one person:

1. USL&H, FELA, Jones Act, and Continental Shelf Act Endorsements, if applicable

c. Commercial General Liability Insurance, written on an occurrence form:

$1,000,000	Each Occurrence (BI & PD Combined Single Limit)
$1,000,000	General Aggregate (per job site)
$1,000,000	Personal Injury Liability to include coverage for employee related claims
$1,000,000	Products and Completed Operations Aggregate
$1,000,000	Contractual Liability to cover all Liabilities assumed under this contract
$ 100,000	All Risk Legal Liability Premises Damage
$ 5,000	Medical Payments

1. Any contractual exclusions relating to personal/advertising injury shall be deleted

2. Any contractual exclusion relating to work performed within 50 feet of a railroad track or work performed for a municipality shall be deleted.

d. Comprehensive Automobile Liability Insurance covering all owned, non-owned and hired automobiles used in connection with the Contractors work, with combined single limit coverage for bodily injury and property damage of not less than $1,000,000 per accident.

e. Professional Liability - if applicable, $2,000,000 each occurrence with not less than a five year completed operations period if claims made coverage.

f. Watercraft protection and indemnity coverage, if applicable $2,000,000 each occurrence.

g. Aircraft liability, if applicable $2,000,000 each occurrence.

h. Owner’s Pollution Liability (i.e. asbestos, lead abatement, pollution) if applicable $500,000 each occurrence with not less than a five years completed operations coverage.

In lieu of the total limits of liability being provided under the primary commercial general liability and automobile liability insurance the Contractor may provide the liability limit specified by means of a combination of primary and umbrella liability insurance. The umbrella liability coverage must be as broad or broader than the primary insurance policies but not less than $10,000,000 each occurrence.

All policies required by the Contractor shall be endorsed to indicate such policies provide primary coverage with respect to the additional insured's without right of contribution by any insurance carried by the additional insured's. A waiver of subrogation in favor of the additional insured's shall also be endorsed to the policies.

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Access to site.
4. Coordination with occupants.
5. Work restrictions.
6. Specification and drawing conventions.
7. Miscellaneous provisions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

A. Project Identification: Cintas Center – Strength & Conditioning Addition

1. Project Location: 1624 Herald Avenue, Cincinnati, OH 45207.

B. Owner: Xavier University. 3800 Victory Parkway, Cincinnati, OH 45207.

1. Owner's Representative: Jim Bergen, Project Manager. (513) 745-4303 bergen@xavier.edu.

C. Architect: MSA Architects. 316 W. 4th St., Cincinnati, OH 45202.

1. Owner's Representative: Chris Bujnak, AIA/Project Manager (513) 241-5666 cbujnak@msaarch.com.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. The project consists of the following:

a. Construction of a new 4,000SF building addition (steel frame concrete wall panel)
b. Renovation of 900SF of interior space.
c. All associated site, structural and MEP&T work.
d. Refer to the Bid Documents for complete project scope.

B. Type of Contract:

1. Project will be constructed under a Single Prime contract: General Contractor

C. Construction Schedule:

1. The Notice to Proceed is expected to be issued on or about **xxxxx**.
2. Contract Time: Work shall commence on the site no earlier than **xxxxx** and be Substantially Complete and ready for use by **xxxxx**. Complete and ready for use means the field can be used by the Owner for its intended purpose.

1.5 ACCESS TO SITE

A. General: Contractor shall have limited use of Project site for construction operations during construction period. Contractor's use of Project site is indicated on the Drawings.

B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated. Contractor shall stay within the site access limits.

1. Limits: Confine construction operations to areas indicated on the Drawings, or in areas approved by the Owner.
2. Driveways, Walkways and Entrances: Keep driveways, public streets and walks, and entrances serving premises clean, clear and available to Owner, Owner’s employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials. Contractor shall use dedicated entrance into the site, separated from vehicular traffic.

a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.6 COORDINATION WITH OCCUPANTS

A. Full Owner Occupancy: Owner will occupy adjacent building(s) and parking lots during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, entrances, and other adjacent occupied or used facilities. Do not close or obstruct walkways, entrances, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

1.7 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Normal business working hours of 7:30 a.m. to 4:00 p.m., Monday through Friday, or as required to meet the project schedule.

1. Weekend Hours: Must be coordinated with the Owner.

C. Existing Utility Interruptions: Owner shall be notified 72 hours prior to interruption.

D. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. 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.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

D. Contract Standard Forms

1. Owner / Contractor Agreement: AIA A101-2007 will be used for this project. Sample copies available upon request, and are not included within this project manual.
2. General Conditions: AIA A201-2007 will be used for this project. A copy is available upon request, and is not included within this project manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012900 - 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:
   1. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

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. Submit the schedule of values to Architect within fourteen (4) days of Notice to Proceed.

B. Format and Content.

   1. Line items on the schedule of values shall include:

      a. Mobilization.
      b. Submittals.
      c. Removal and Disposal.
      d. Turf labor and materials.
      e. Infill labor and materials.
      f. Testing and surveying.
      g. Punchlist/Project Closeout.

   2. Arrange schedule of values consistent with format of AIA Document G703.
   3. 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.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and Construction Manager 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.

2. Should advance payment be required to obtain certain materials, or should carrying charges be incurred, the Contractor shall notify the Owner and the Architect in writing and by quantifying the amounts and timing for that payment in the Schedule of Values.

B. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

C. 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. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

D. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed.

E. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect.

F. Final Payment Application: After completing Project closeout requirements, 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 liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General coordination procedures.
2. Requests for Information (RFIs).
3. Project meetings.

B. Related Requirements:

1. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
2. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 5 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.

1.6 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
2. Coordinate and submit RFIs 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 information or interpretation and the following:

1. Project name.
2. Project number.
3. Date.

4. Name of Contractor.
5. Name of Architect.
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor's signature.
13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: Software-generated form, acceptable to Architect.

1. Attachments shall be electronic files in Adobe Acrobat PDF format.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow five working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Architect's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to the General Conditions.

    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

1.7 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: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 10 days after the Notice to Proceed.

1. Conduct the conference to review responsibilities and personnel assignments.
2. Attendees: Authorized representatives of Owner Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Tentative construction schedule.
    b. Critical work sequencing and long-lead items.
    c. Designation of key personnel and their duties.
    d. Lines of communications.
    e. Procedures for processing field decisions and Change Orders.
    f. Procedures for RFIs.
    g. Procedures for testing and inspecting.
    h. Procedures for processing Applications for Payment.
    i. Distribution of the Contract Documents.
    j. Submittal procedures.
    k. Preparation of record documents.
    l. Use of the premises.
    m. Work restrictions.
    n. Working hours.
    o. Owner’s work.
    p. Owner's occupancy requirements.
    q. Responsibility for temporary facilities and controls.
    r. Procedures for disruptions and shutdowns.
    s. Parking availability.
    t. Office, work, and storage areas.
    u. Equipment deliveries and priorities.
    v. First aid.
    w. Security.
    x. Progress cleaning.

4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Progress Meetings: Will be held weekly until the project completion date.

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 meeting 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.

        1) Review schedule for next period.

    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) Progress cleaning.
        10) Quality and work standards.
        11) Status of correction of deficient items.
        12) Field observations.
        13) Status of RFIs.
        14) Status of proposal requests.
        15) Pending changes.
        16) Status of Change Orders.
        17) Pending claims and disputes.
        18) Documentation of information for payment requests.

3. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

    a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Requirements:

1. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal category: Action; informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Architect's final release or approval.
    g. Scheduled date of fabrication.
    h. Scheduled dates for purchasing.
    i. Scheduled dates for installation.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

B. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 7 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 7 days for review of each resubmittal.
4. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 7 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

C. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.

    a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Architect**,** containing the following information:

    a. Project name.
    b. Date.
    c. Name and address of Architect.
    d. Name of Contractor.
    e. Name of firm or entity that prepared submittal.
    f. Names of subcontractor, manufacturer, and supplier.
    g. Category and type of submittal.
    h. Submittal purpose and description.
    i. Specification Section number and title.
    j. Specification paragraph number or drawing designation and generic name for each of multiple items.
    k. Drawing number and detail references, as appropriate.
    l. Location(s) where product is to be installed, as appropriate.
    m. Related physical samples submitted directly.
    n. Indication of full or partial submittal.
    o. Transmittal number, numbered consecutively.
    p. Submittal and transmittal distribution record.
    q. Other necessary identification.
    r. Remarks.

D. Options: Identify options requiring selection by Architect.

E. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

F. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

G. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

H. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Submit electronic submittals as PDF electronic files via email to Architect.

    a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

    a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.

4. Submit Product Data before or concurrent with Samples.
5. Submit Product Data in the following format:

    a. PDF electronic file.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.
    f. Relationship and attachment to adjoining construction clearly indicated.
    g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
3. Submit Shop Drawings in the following format:

    a. PDF electronic file.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:

    a. Generic description of Sample.
    b. Product name and name of manufacturer.
    c. Sample source.
    d. Number and title of applicable Specification Section.
    e. Specification paragraph number and generic name of each item.

3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit two full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit three sets of Samples. Architect will retain one Sample sets; remainder will be returned.

E. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."

F. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."

G. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."

H. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

I. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

J. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

K. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

L. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

M. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

N. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

O. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

    1. Name of evaluation organization.
    2. Date of evaluation.

3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

P. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

Q. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

R. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

S. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

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.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."

C. 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.

3.2 ARCHITECT'S ACTION

A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 013300

SECTION 015000 – TEMPORARY FACILITIES & CONTROLS

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. The following items are described within this section:

1. Telephones
2. Ground Fault Protection
3. Temporary Water
4. Sanitary Facilities
5. Safety Barriers
6. Construction Fence
7. Cleaning During Construction
8. Final Cleanup
9. On-site Storage Availability
10. Traffic Control
11. Project Sign
12. Fire Extinguisher
13. Security
15. Temporary Electric

1.3 TELEPHONES

A. Telephones must be provided by Contractor. Field Superintendents must be equipped with cellular phones at all times.

1.4 GROUND FAULT PROTECTION

A. It is Contractor's responsibility to use cords and equipment that meet all code and OSHA requirements, including ground fault protection on all extension chords.

1.5 TEMPORARY WATER

A. Contractor is responsible for supplying all water, ice and cups for their consumption. Proper disposal of used cups and ice bags is the responsibility of each contractor.

B. Owner’s water supply, within reason, may be used for water needed for construction.

1.6 SANITARY FACILITIES

A. Temporary chemical type toilet facilities are to be supplied by the Contractor for the duration of the project. Use of the Owner's facilities will NOT be permitted.

1.7 SAFETY BARRIERS

A. Contractor will be required to construct and maintain OSHA approved safety barriers throughout the duration of the project.

1.8 CLEANING DURING CONSTRUCTION

A. Contractor is to remove all rubbish and broom clean daily.

B. Dumpsters are to be provided by the Contractor. For construction trash only.

1.9 FINAL CLEANUP

A. See Section 017700 for additional information.

1.10 ON-SITE STORAGE

A. The Contractor shall coordinate with the Owner all available space for on-site storage.

B. Trailer, if required and electric service will be the responsibility of Contractor.

1.11 TRAFFIC CONTROL/DELIVERIES

A. It will be Contractor's responsibility to coordinate deliveries with Client and available parking and access driveways. Traffic Control on public roads will be Contractor's responsibility.

B. Staging for on site material storage is Contractor's responsibility and must be coordinated with the Owner.

C. Contractor's worker parking on site shall be coordinated with the Owner.

1.12 PROJECT SIGNS

A. Only permissible signs shall be for safety and protection.

1.13 FIRE EXTINGUISHER

A. Contractor shall have their own fire watch and prevention program and provide extinguisher and blankets as required.

1.14 SECURITY

Contractor will be responsible to secure all of their tools, equipment and materials.

1.15 TEMPORARY ELECTRIC

A. Contractor is responsible for their own temporary electric, if required.

END OF SECTION 015000

SECTION 017300 - PROJECT EXECUTION

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 general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Installation of the Work.
3. Cutting and patching.
4. Progress cleaning.
5. Protection of installed construction.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "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 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

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

1.4 QUALITY ASSURANCE

A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction 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.

B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

B. 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 Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

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 caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

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.

B. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 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.

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. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

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

G. 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 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Temporary Support: Provide temporary support of work to be cut.

C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

E. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
3. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
4. Proceed with patching after construction operations requiring cutting are complete.

F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.

3.6 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

a. Use containers intended for holding waste materials of type to be stored.

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.

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. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

F. 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.

G. 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.

3.7 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.

END OF SECTION 017300

SECTION 017700 - 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

B. Related Requirements:

1. Section 017300 "Project Execution" for progress cleaning of Project site.
2. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 ACTION SUBMITTALS

A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

B. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

1.5 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
2. Complete final cleaning requirements.
3. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. 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.

1.6 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to the General Conditions.
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

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

1. 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.

2. Submit list of incomplete items in the following format:

a. MS Excel electronic file. Architect will return annotated file.

1.8 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: 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, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch 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.
4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

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 FINAL CLEANING

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

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated 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.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

END OF SECTION 017700

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings.
2. Record Product Data.
3. Miscellaneous record submittals.

B. Related Requirements:

1. Section 017700 "Closeout Procedures" for general closeout procedures.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up record prints.
2. Number of Copies: Submit copies of record Drawings as follows:

a. Initial Submittal:

1) Submit PDF electronic files of scanned record prints and one of file prints.
2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:

1) Submit PDF electronic files of scanned record prints and three set(s) of prints.
2) Print each drawing, whether or not changes and additional information were recorded.

B. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

C. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. Accurately record information in an acceptable drawing technique.
    c. Record data as soon as possible after obtaining it.
    d. Record and check the markup before enclosing concealed installations.
    e. Cross-reference record prints to corresponding archive photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Revisions to routing of piping and conduits.
    d. Changes made by Change Order or Construction Change Directive.
    e. Changes made following Architect's written orders.
    f. Details not on the original Contract Drawings.
    g. Field records for variable and concealed conditions.
    h. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file.

2.2 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders and record Drawings where applicable.

B. Format: Submit record Product Data as annotated PDF electronic file.

1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.3 MISCELLANEOUS RECORD SUBMITTALS

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

B. Format: Submit miscellaneous record submittals as PDF electronic file.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

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

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 017839

SECTION 024116 - STRUCTURE DEMOLITION

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. Demolition and removal of buildings and site improvements.
2. Removing below-grade construction.
3. Disconnecting, capping or sealing, and removing site utilities.
4. Salvaging items for reuse by Owner.

B. Related Requirements:

1. Section 011000 "Summary" for use of the premises and phasing requirements.
2. Section 013200 "Construction Progress Documentation" for preconstruction photographs taken before building demolition.
3. Section 024119 "Selective Demolition" for partial demolition of buildings, structures, and site improvements.
4. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade site improvements not part of building demolition.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse. Include fasteners or brackets needed for reattachment elsewhere.

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 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

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 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Engineering Survey: Submit engineering survey of condition of building.

C. Proposed Protection Measures: Submit 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 including means of egress from those buildings.

D. Schedule of Building Demolition Activities: Indicate the following:

1. Detailed sequence of demolition work, with starting and ending dates for each activity.
2. Temporary interruption of utility services.
3. Shutoff and capping or re-routing of utility services.

E. Predemolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces, which might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before the Work begins.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

1.9 FIELD CONDITIONS

A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.

B. Buildings immediately adjacent to demolition area will 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, 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. Maintain routes and facilities for deliveries

C. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before building demolition, Owner will remove the following items:

a. Owner will remove miscellaneous equipment and contents prior to the start of demolition. Some equipment and contents may remain and become part of the demolition/removal.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials may currently exist in the buildings, and will be removed by Owner before start of the Work. A report on the presence of hazardous materials and removals is on file for review and use. Examine report to become aware of locations where hazardous materials may have been present.
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.

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

1.10 COORDINATION

A. Arrange demolition schedule so as not to interfere with Owner's on-site operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

B. Standards: Comply with ASSE A10.6 and NFPA 241.

2.2 SOIL MATERIALS

A. Satisfactory Soils: Comply with requirements in Section 312000 "Earth Moving."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.

D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

E. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations. Comply with Section 013233 "Photographic Documentation.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

B. Salvaged Items: Comply with the following:

1. Clean salvaged items of dirt and demolition debris.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to storage area designated by Owner.
5. Protect items from damage during transport and storage.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Utilities to be Disconnected: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished.
1. Arrange to shut off utilities with utility companies.
2. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
3. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.

4. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.4 PROTECTION

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

B. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of demolition.

C. Existing Utilities to Remain: 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.

D. 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 Section 015000 "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.

E. 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.

3.5 DEMOLITION, GENERAL

A. General: Demolish indicated buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
2. Maintain fire watch during and for at least 2 hours after flame-cutting operations.
3. Maintain adequate ventilation when using cutting torches.
4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Site Access and Temporary Controls: Conduct building 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 trafficways if required by authorities having jurisdiction.
2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

C. Explosives: Use of explosives is not permitted.

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 removed and 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.

3.7 SITE RESTORATION

A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.

B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.8 REPAIRS

A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.9 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site

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

B. Do not burn demolished materials.

3.10 CLEANING

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

1. Clean roadways of debris caused by debris transport.

END OF SECTION 024116

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Demolition and removal of selected portions of building or structure.
2. Salvage of existing items to be reused or recycled.

B. Related Sections include the following:

1. Division 01 Section "Summary" for use of premises, special requirements regarding selective demolition, and Owner-occupancy requirements.
2. Division 01 Section "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for selective demolition operations.
3. Division 01 Section "Cutting and Patching" for cutting and patching procedures.

1.3 DEFINITIONS

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

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. 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. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.

1. Coordinate with Owner, who will establish special procedures for removal and salvage.

1.5 SUBMITTALS

A. 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. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Locations of proposed dust- and noise-control temporary partitions and means of egress.
6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
7. Means of protection for items to remain and items in path of waste removal from building.

B. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.

C. Predemolition Photographs or Videorecording: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Provide copy to the Owner on DVD.

D. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.6 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

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

D. Standards: Comply with ANSI A10.6 and NFPA 241.

E. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.7 PROJECT CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

1. Comply with requirements specified in Division 01 Section "Summary."

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before selective demolition, Owner will remove the following items:

a. Furniture and equipment in the direct path of construction and demolition. Some existing furniture and equipment will remain in place during the construction period.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: Known hazardous materials will be abated as part of this work. It is not expected that additional hazardous materials will be encountered in the Work.

1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 WARRANTY

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

PART 2 - PRODUCTS (Not Used)

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.

E. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or preconstruction videotapes.

G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.

1. Comply with requirements for existing services/systems interruptions specified in Division 01 Section "Summary"

B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off indicated utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

    a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.3 PREPARATION

A. 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. Comply with requirements for access and protection specified in Division 1 Section "Temporary Facilities and Controls."

B. 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 and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 1 Section "Temporary Facilities and Controls."

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations, and a fire watch after cutting operations for 2 hours.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly.

B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.

3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area on-site as designated by Owner.
5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

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

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.

1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.

E. Roofing: Remove no more existing roofing than can be covered in one day by temporary measures, curbs and flashings and so that building interior remains watertight and weathertight.

F. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

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

3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

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

3.7 CLEANING

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

END OF SECTION 024119

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Grade beams.
2. Foundation walls.
3. Structural slabs-on-grade.
4. Concrete toppings.

B. Related Sections:

1. Section 033300 "Architectural Concrete" for general building applications of specially finished formed concrete.
2. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.
3. Section 321313 "Concrete Paving" for concrete pavement and walks.
4. Section 321316 "Decorative Concrete Paving" for decorative concrete pavement and walks.
5. Section 072629 “Below-Grade Vapor and Gas retarders” for vapor retarders.

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

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

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Data for Credit IEQ 4.3: For curing and sealing compounds, documentation including printed statement of VOC content.

3. Design Mixtures for Credit ID 1.1: For each concrete mixture containing fly ash as a replacement for portland cement or other portland cement replacements, and for equivalent concrete mixtures that do not contain portland cement replacements.

C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

E. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

F. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Architect.

G. Samples: For waterstops and vapor retarder.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer, and testing agency.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Semirigid joint filler.
13. Joint-filler strips.
14. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

F. Field quality-control reports.

G. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

H. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete subcontractor.
e. Special concrete finish subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.7 DELIVERY, STORAGE, AND HANDLING

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

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed or ASTM A996 (A996 bars from rail steel shall be Type R), 60 ksi yield, deformed.

C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

D. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60 ASTM A 706/A 706M, deformed bars, epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.

E. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Epoxy-Coated Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, ASTM A 775/A 775M epoxy coated.

C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M.

D. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.

E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II, gray. Supplement with the following:

a. Fly Ash: ASTM C 618, Class F or C.
b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Silica Fume: ASTM C 1240, amorphous silica.

C. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Water: ASTM C 94/C 94M and potable.

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

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

C. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

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

a. ChemMasters.
b. Davis Colors.
c. Dayton Superior Corporation.
d. Hoover Color Corporation.
e. Lambert Corporation.

f. QC Construction Products.
g. Rockwood Pigments NA, Inc.
h. Scofield, L. M. Company.
i. Solomon Colors, Inc..

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

2.6 WATERSTOPS

A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Carlisle Coatings & Waterproofing, Inc.; MiraSTOP.
b. CETCO; Volclay Waterstop-RX.
c. Concrete Sealants Inc.; Conseal CS-231.
d. Greenstreak; Swellstop.
e. Henry Company, Sealants Division; Hydro-Flex.
f. JP Specialties, Inc.; Earth Shield Type 20..

2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
b. BASF Construction Chemicals - Building Systems; Confilm.
c. ChemMasters; SprayFilm.
d. Conspec by Dayton Superior; Aquafilm.
e. Dayton Superior Corporation; Sure Film (J-74).
f. Edoco by Dayton Superior; BurkeFilm.
g. Euclid Chemical Company (The), an RPM company; Eucobar.
h. Kaufman Products, Inc.; Vapor-Aid.
i. Lambert Corporation; LAMBCO Skin.
j. L&M Construction Chemicals, Inc.; E-CON.
k. Meadows, W. R., Inc.; EVAPRE.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group; MONOFILM.
n. Sika Corporation; SikaFilm.
o. SpecChem, LLC; Spec Film.
p. Symons by Dayton Superior; Finishing Aid.
q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
r. Unitex; PRO-FILM.
s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Construction Chemicals - Building Systems; Kure 1315.
b. ChemMasters; Polyseal WB.
c. Conspec by Dayton Superior; Sealcure 1315 WB.
d. Edoco by Dayton Superior; Cureseal 1315 WB.
e. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.
f. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
g. Lambert Corporation; UV Safe Seal.
h. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
i. Meadows, W. R., Inc.; Vocomp-30.
j. Metalcrete Industries; Metcure 30.
k. Right Pointe; Right Sheen WB30.
l. Symons by Dayton Superior; Cure & Seal 31 Percent E.
m. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.
n.

2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.8 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

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

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.9 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than at 28 days when tested according to ASTM C 109/C 109M.

2.10 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Ground Granulated Blast-Furnace Slag: 50 percent.
4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete and concrete with a water-cementitious materials ratio below 0.50.

E. 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.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Grade Beams: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.50.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

B. Foundation Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.50.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

C. Structural Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Minimum Cementitious Materials Content: 540 lb/cu. yd..
3. Slump Limit: 5 inches, plus or minus 1 inch.
4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.12 FABRICATING REINFORCEMENT

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

2.13 CONCRETE MIXING

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

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

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class B, 1/4 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

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

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

B. Granular Course: Cover vapor retarder with granular fill, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.

1. Place and compact a 1/2-inch- thick layer of fine-graded granular material over granular fill.

3.6 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOPS

A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.9 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

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

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

1. Apply scratch finish to surfaces indicated

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
    a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
    b. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.12 MISCELLANEOUS CONCRETE ITEMS

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

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not

less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least [**one**] [**six**] month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

3.15 CONCRETE SURFACE REPAIRS

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

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.16 FIELD QUALITY CONTROL

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

B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete;one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.

7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
10. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness according to ASTM E 1155 within 48 hours of finishing.

END OF SECTION 03 30 00

SECTION 034713 - TILT-UP CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes load-bearing, tilt-up concrete, including the following:

1. Monolithic panels.
2. Insulated-sandwich panels.

B. Related Requirements:

1. Section 076200 "Sheet Metal Flashing and Trim" for flashing receivers and reglets.

1.3 DEFINITIONS

A. Face-down Surface: Concealed surface of as-cast, tilt-up panel formed against the casting slab.

B. Face-up Surface: Exposed upper surface of as-cast, tilt-up panel.

C. Reveal: Projection of the coarse aggregate from the matrix after exposure.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at the project site.

1. Before submitting design mixes, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with tilt-up concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Tilt-up concrete Subcontractor.

2. Review special inspection procedures, testing and inspecting agency procedures for field quality control, tilt-up concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, casting-slab construction, flatness and levelness, finish, and joint requirements, steel reinforcement installation, hoisting and erection plans, measurement of fabrication and erection tolerances, tilt-up concrete repair procedures, and tilt-up concrete protection.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings: Detail fabrication and installation of tilt-up concrete units. Indicate panel locations, plans, elevations, dimensions, shapes, cross sections, and details of steel embedments. Match panel identification designations on Shop Drawings with those on Contract Drawings.

1. Include steel reinforcement, detailing fabrication, bending, and placing. Include material, grade, bar schedules, stirrup spacing, bent-bar diagrams, arrangement, and supports of concrete reinforcement.
2. Include additional steel reinforcement to resist hoisting and erection stresses.
3. Include locations and details of hoisting points and lifting devices for handling and erection.
4. Include engineering analysis data of additional steel reinforcement and hoisting and erection details, signed and sealed by the qualified professional engineer responsible for their preparation.
5. Indicate welded connections by AWS standard symbols. Detail cast-in inserts, connections, and joints, including accessories.
6. Include layout of wythe connectors for sandwich panels.

D. Samples: 20-lb Sample of exposed aggregate.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer, testing agency.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Steel reinforcement and accessories.
4. Bond breakers.
5. Curing compounds.
6. Inserts and embedments.
7. Sandwich-panel insulation and wythe connectors.

D. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates - Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Installer Qualifications: A qualified installer who employs a supervisor on Project who is an ACI-certified Tilt-up Supervisor.

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade I, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M.
2. AWS D1.4/D1.4M.

E. Mockups: Cast and erect tilt-up concrete panel mockups to demonstrate typical reveals, surface finishes, texture, color, and standard of workmanship.

1. Build mockup panels in the location and of the size indicated or, if not indicated, as directed by Architect.
2. In presence of Architect, damage part of an exposed surface for each finish, color, and texture required, and demonstrate materials and techniques proposed for repairs to match adjacent undamaged surfaces.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete mixtures.

PART 2 - PRODUCTS

2.1 TILT-UP CONCRETE

A. Comply with ACI 301, unless modified by requirements in the Contract Documents.

2.2 FORMS AND ACCESSORIES

A. Forms: Metal, dressed lumber, or other approved materials that are nonreactive with concrete and that will provide continuous, true, and smooth concrete surfaces.

B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch.

C. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface treatments of concrete.

D. Reveal Strips: Metal, PVC, rubber, straight dressed wood, or plywood; with sides kerfed.

E. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleedwater and prevent migration of set-retarding chemicals from wood or plywood.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

C. Plain-Steel Wire: ASTM A 82/A 82M, galvanized.

D. Plain-Steel Welded-Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.

E. Deformed-Steel Welded-Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

F. Bar Supports: Manufactured according to CRSI's "Manual of Standard Practice" of plastic or CRSI Class 1 plastic-protected steel wire or Class 2 stainless-steel wire.

2.4 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Material:

1. Portland Cement: ASTM C 150/C 150M, [**Type I**] [**Type II**] [**Type I/II**] [**Type III**] [**Type V**], [**gray**] [**white**].
2. Fly Ash: ASTM C 618, [**Class F**] [**Class C**].
3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
4. Blended Hydraulic Cement: ASTM C 595/C 595M, [**Type IS**] [**Type IP**] [**Type IL**] [**Type IT**].

C. Coarse Aggregate: ASTM C 33/C 33M, [**Class 4S**] [**Class 4M**] [**Class 1N**] <**Insert class**> coarse aggregate or better, graded. Provide aggregates from single source[**with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials**].

1. Maximum Coarse-Aggregate Size: [**1 inch**] [**3/4 inch**] <**Insert dimension**> nominal.

D. Fine Aggregate: [**ASTM C 33/C 33M**] [**or**] [**ASTM C 144**], manufactured or natural sand, from same source for Project, free of materials with deleterious reactivity to alkali in cement.

E. Exposed Coarse Aggregate: Hard and durable; washed; free of material that reacts with cementitious material or causes staining; from single source, as follows:

1. Aggregate Sizes: [**3/4 to 1 inch**] [**1/2 to 3/4 inch**] [**3/8 to 5/8 inch**] <**Insert dimension**> nominal.
2. Gradation: Uniformly graded.
3. Source and Material: <**Insert source and material**>.

F. Air-Entraining Admixture: ASTM C 260/C 260M.

G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

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

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

1. Color: To match adjacent existing concrete tilt-up panels (as provided by ATMI Precast), and as selected by the Architect from the manufacturer’s full range.

I. Water: ASTM C 94/C 94M.

2.5 BOND BREAKERS

A. Solvent-Borne, Chemically Reactive Bond Breaker: Penetrating polymerized solution containing no oils, waxes, paraffins, or silicones, and compatible with casting-slab curing compound.

B. Solvent-Borne, Membrane-Forming Bond Breaker: Dissipating polymerized solution containing no oils, waxes, paraffins, or silicones, and compatible with casting-slab curing compound.

C. Waterborne, Chemically Reactive Bond Breaker: Penetrating polymerized emulsion containing no oils, waxes, paraffins, or silicones, and compatible with casting-slab curing compound.

D. Waterborne, Membrane-Forming Bond Breaker: Dissipating polymerized emulsion containing no oils, waxes, paraffins, or silicones, and compatible with casting-slab curing compound.

2.6 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

2.7 CONNECTION MATERIALS

A. Embedded Metal Items and Loose Hardware: Comply with Section 055000 "Metal Fabrications" for materials for securing tilt-up concrete panels together and to supporting and adjacent construction.

B. Loose Hardware: Comply with Section 055000 "Metal Fabrications" for materials for securing tilt-up concrete panels together and to supporting and adjacent construction.

C. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.

D. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A; carbon-steel, hex-head bolts and studs; carbon-steel nuts; and flat, unhardened steel washers.

E. Unheaded Carbon-Steel Rods and Nuts: ASTM A 36/A 36M, threaded rods with ASTM A 563, nuts.

F. Welded Headed Studs: AWS D1.1/D1.1M, Type B headed studs, and cold-finished, carbon-steel bars.

G. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

H. Chord Bar Sleeves: Tubular sheathing, plastic or moisture-resistance-treated cardboard.

I. Welding Electrodes: Comply with AWS standards.

J. Hot-Dip Galvanized Finish: Apply zinc coating to steel connections by hot-dip process, complying with ASTM A 123/A 123M or ASTM A 153/A 153M as applicable.

1. Zinc Repair Paint: SSPC-Paint 20.

K. Shop-Primed Finish: Prepare surfaces of steel connections, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3, and shop-apply primer according to SSPC-PA 1.

1. Primer: MPI#79

2.8 LIFTING INSERTS AND ACCESSORIES

A. Furnish inserts, dowels, bolts, nuts, washers, and other items to be cast in panels for tilting and lifting.

1. Manufacture inserts with feet of plastic, galvanized-steel wire, plastic-tipped steel wire, or stainless-steel-tipped steel wire.

B. Furnish brace anchors and other accessories to be cast in panels and in casting slab for attaching bracing.

1. Manufacture wall brace anchors and accessories with feet of galvanized-steel wire, plastic-tipped steel wire, or stainless-steel-tipped steel wire.
2. Manufacture floor brace anchors that do not penetrate vapor retarder under slab-on-grade.

2.9 BEARING PADS

A. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet; Type A Shore durometer hardness of 50 to 70, ASTM D 2240; and minimum tensile strength of 2250 psi, ASTM D 412.

B. Random, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer with a Type A Shore durometer hardness of 70 to 90, ASTM D 2240.

C. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded in elastomer with a Type A Shore durometer hardness of 80 to 100, ASTM D 2240.

D. High-Density Plastic Strips: Multimonomer, nonleaching plastic.

2.10 GROUT

A. Cement Grout: Portland cement, ASTM C 150/C 150M, Type I, and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents; complying with ASTM C 1107, of consistency suitable for application.

2.11 SANDWICH-PANEL INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, square edged.

1. 3” EPS, match existing panels.

2.12 SANDWICH-PANEL ACCESSORIES

A. Fiber-Polymer Composite Wythe Connectors: Manufactured composite glass-fiber and vinyl-ester polymer connector rods, notched, with polymer collars injection molded around shaft of connector rod; alkaline resistant; for noncomposite structural action.

B. Resin Wythe Connectors: Manufactured thermoplastic resin connector rods, notched, with integral flange around shaft of connector rod; alkaline resistant; for noncomposite structural action.

C. Stainless-Steel Wythe Connectors: Manufactured of stainless-steel sheet, ASTM A 240/A 240M, Type 304; round tube and rectangular flat anchors; punched with round holes for anchor rods and oval holes for concrete bond; equipped with bright, hard-drawn steel wire anchor rods, 1/4 inch in diameter, 28 inches long; and L-shaped crimped connector pins manufactured of stainless-steel wire, ASTM A 580/A 580M, Type 304; for noncomposite structural action.

D. Polyethylene Sheet: ASTM D 4397, 4 mils thick.

2.13 MISCELLANEOUS MATERIALS

A. Chemical Surface Retarder: Water-soluble, liquid set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to depth of reveal or etch required of specified finish.

B. Form Retarder: Chemical liquid set retarder, for application on hardened horizontal concrete and capable of temporarily delaying final hardening of newly placed concrete to depth of reveal specified.

1. Mold Release: Solution specially formulated by manufacturer for use under form retarder.

C. Flashing Reglets: Open type having continuous groove not less than 1-1/8 inches deep by 3/16 inch wide at opening and sloped upward to 45 degrees. Temporarily fill or cover face openings of reglets to prevent intrusion of concrete or debris.

1. Stainless Steel: ASTM A 240/A 240M, Type 304, soft annealed, not less than 0.0187 inch thick.
2. Copper Strip: ASTM B 370, Temper H00 or O60, not less than 16 oz./sq. ft..
3. Hot-Dip Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 coating, not less than 0.0217 inch thick.

D. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.0336 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.14 REPAIR MATERIALS

A. Bonding Agent: ASTM C 1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

B. Patching Mortar: Dry-pack mix consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing No. 16 sieve, using only enough water for handling and placing.

2.15 CONCRETE MIXTURES

A. Obtain each color, size, type, and variety of concrete mixture from single manufacturer with resources to provide concrete of consistent quality in appearance and physical properties.

B. Prepare design mixtures for each type and strength of concrete, proportioned on basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures based on laboratory trial mixtures.

C. Proportion concrete mixture as follows:

1. Minimum Compressive Strength: [**5000 psi**] [**4500 psi**] [**4000 psi**] [**3500 psi**] [**3000 psi**] <**Insert value**> at 28 days.
2. Maximum W/C Ratio: [**0.50**] [**0.45**] [**0.40**] <**Insert ratio**>.
3. Slump Limit: [**4 inches**] [**5 inches**] [**8 inches for concrete with verified slump of 2 to 4 inches before adding high-range, water-reducing admixture or plasticizing admixture**] <**Insert dimension(s)**>, plus or minus 1 inch.
4. Air Content: [**5-1/2**] <**Insert number**> percent plus or minus 1.5 percent for 1-1/2-inch nominal maximum aggregate size at point of delivery.
5. Air Content: [**6**] <**Insert number**> percent plus or minus 1.5 percent for [**1-inch**] [**3/4-inch**] nominal maximum aggregate size at point of delivery.
6. Cementitious Materials:[**Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.**] [**Limit percentage, by weight, of cementitious materials other than portland cement in concrete according to ACI 301 requirements.**]

D. Limit water-soluble, chloride-ion content in hardened concrete to [**0.15**] [**0.30**] percent by weight of cement.

E. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use [**water-reducing**] [**high-range, water-reducing**] [**or**] [**plasticizing**] admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

F. 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.

2.16 CONCRETE MIXING

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

1. When air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site-Produced Concrete: Measure, batch, and mix concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. Provide a batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record panel locations where concrete is deposited.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Construct and brace formwork so tilt-up concrete panels are of size, shape, alignment, elevation, and position indicated.

1. Construct forms on slab-on-grade or on temporary casting slab, at Contractor's option.
2. Provide for openings, offsets, recesses, reveals, rustications, reglets, and blockouts.
3. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concreting. Coat form liner with form-release agent.

B. Construct forms for easy removal without hammering or prying against concrete surfaces. Use kerfed inserts, such as those forming reglets, rustications, and recesses, for easy removal.

C. Set edge forms for panels to achieve required panel thickness.

D. Chamfer exposed corners and edges, unless otherwise indicated, using chamfer strips fabricated to produce uniform, smooth lines and tight edge joints.

E. Coat contact surfaces of wood forms and chamfers with sealer before placing reinforcement.

3.2 BOND BREAKER INSTALLATION

A. Uniformly and continuously apply two coats of bond breaker to casting-slab surfaces by power spray or roller according to manufacturer's written instructions, before placing steel reinforcement. Recoat areas subjected to moisture before drying. Maintain continuity of coating until concrete placement.

B. After placing steel reinforcement, touch up or recoat worn or damaged areas with bond breaker. Do not splash or coat steel reinforcement and inserts.

3.3 FORM RETARDER APPLICATION

A. Uniformly and continuously apply form retarder to slab surfaces by power spray, roller, or brush according to manufacturer's written instructions, before placing steel reinforcement. Recoat areas subjected to moisture before drying. Maintain continuity of coating until concrete placement.

1. Uniformly apply mold release according to manufacturer's written instructions and allow it to dry before applying form retarder.

B. After placing steel reinforcement, touch up or recoat worn or damaged areas with form retarder. Do not splash or coat steel reinforcement and inserts.

3.4 REINFORCEMENT AND INSERT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating and placing reinforcement.

B. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover.

1. Field weld reinforcement according to AWS D1.4/D1.4M, where indicated.
2. Do not tack-weld crossing reinforcing bars.
3. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

C. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

D. Accurately place and securely support embedded items, anchorages, inserts, cramps, retainers, bar chords and sleeves, and other items to be built into panels. Coordinate with other trades for installing cast-in items.

E. Wythe Connectors: Accurately place and securely support stainless-steel anchors and connecting pins for sandwich panels.

3.5 PANEL CASTING, GENERAL

A. Comply with ACI 301 for handling, placing, and consolidating concrete.

B. Maintain position of steel reinforcement, inserts, and anchors during concrete placement, consolidation, and finishing.

C. Screed panel surfaces to correct level with a straightedge and strike off.

1. Begin initial floating before excess moisture or bleedwater appears on the surface. Use bull floats or darbies to form a uniform and open-textured surface plane free of humps or hollows. Do not disturb panel surfaces before beginning finishing operations.

D. Form chamfers at top edges of panel perimeters, openings, and similar locations not formed by chamfer strips unless otherwise indicated.

E. Surface Defects: Limit visible surface defects to those permitted by TCA's "Tilt-up Concrete Association's Guideline Specifications" for Grade A, Architectural panel surfaces.

3.6 SANDWICH-PANEL CASTING

A. Cast and screed supported wythe over casting slab.

B. Fiber-Polymer Composite Wythe Connectors:

1. While concrete is still plastic, place polyethylene sheet over top surface, overlapping sheet edges 6 inches and extending beyond edges of panels.

2. Immediately place insulation, abutting edges and ends between boards. Stagger end joints between rows. Stagger joints of insulation layers one-half of board apart. Insert wythe connectors through predrilled insulation, and consolidate concrete around connectors according to manufacturer's written instructions.

C. Stainless-Steel Wythe Connectors: Place insulation through projecting connectors, abutting edges and ends between boards. Stagger end joints between rows. Stagger joints of insulation layers one-half of board apart.

1. Place polyethylene sheet over insulation, overlapping edges 6 inches and extending beyond edges of panels.

D. Cast, screed, and apply initial float finish to structural wythe.

3.7 CASTING TOLERANCES

A. Cast tilt-up concrete panels without exceeding the following tolerances:

1. Height and Width of Panels:

   a. For Panels up to 20 Feet Tall: 1/4 inch wide.
   b. For Panels 20 to 30 Feet Tall: 3/8 inch wide.
   c. Each Additional 10 Feet in Excess of 30 Feet Tall: 1/8 inch wide.

2. Thickness: 3/16 inch.
3. Skew of Panel or Opening: Difference in length of diagonals of 1/8 inch per 72 inches with a maximum difference of 1/2 inch.
4. Openings Cast into Panel:

   a. Size of Opening: 1/4 inch.
   b. Location of Centerline of Opening: 1/4 inch.

5. Location and Placement of Embedded Items:

   a. Inserts, Bolts, and Pipe Sleeves: 3/8 inch.
   b. Lifting and Bracing Inserts: As required by manufacturer.
   c. Lateral Placement of Weld Plate Embedments: 1 inch.
   d. Tipping and Flushness of Weld Plate Embedments: 1/4 inch.

6. Deviation of Steel Reinforcement Cover: Maintain minimum cover required by ACI 301.

3.8 FACE-UP FINISHES

A. Face-Up finishes to match adjacent existing panels (as provided by ATMI Precast).

B. Float Finish: Consolidate surface of plastic concrete with power-driven floats or by hand floating. Restraighten and cut down high spots and fill low spots. Repeat float passes and restraighten until surface is left with a uniform, smooth, granular texture.

C. Trowel Finish: After applying float finish, apply first trowel finish and consolidate plastic concrete by hand trowel or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and is uniform in texture and appearance.

D. Trowel and Fine-Broom Finish: After applying float finish, apply a partial trowel finish to plastic concrete, stopping after second troweling. Immediately after second troweling, and when concrete is still plastic, slightly scarify the surface with a fine broom.

1. Broom surface in a side-to-side direction.

E. Brushed Exposed-Aggregate Finish: Produce exposed-aggregate finish to exterior surface of concrete by washing and brushing before panel erection, as follows:

1. Immediately after floating, broadcast a single layer of aggregate uniformly onto panel surface. Tamp seeded aggregate into plastic concrete and float to embed aggregate with mortar cover of 1/16 inch.
2. Spray chemical surface retarder on panel according to manufacturer's written instructions.
3. Cover panel surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.
4. Without dislodging aggregate, remove excess mortar by lightly brushing surface with stiff nylon-bristle broom.
5. Fine spray surface with water, and brush. Repeat water flushing and brushing cycle until cement film is removed from aggregate surfaces to depth required.

F. Abrasive-Blast, Exposed-Aggregate Finish: Produce exposed-aggregate finish to exterior surface of concrete by abrasive-blast finish before panel erection, as follows:

1. Immediately after floating, spray chemical surface retarder on panel surface according to manufacturer's written instructions.
2. Cover with plastic sheeting, sealing laps with tape, and remove after concrete has hardened.
3. Apply abrasive-blast finish using abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces as follows:

    a. Light Exposure: Expose fine aggregate with occasional exposure of coarse aggregate and uniform color; maximum reveal of 1/16 inch.
    b. Medium Exposure: Generally expose coarse aggregate with slight reveal; maximum reveal of 1/4 inch.
    c. Heavy Exposure: Expose and reveal coarse aggregate to a maximum projection of one-third of its diameter; reveal of 1/4 to 1/2 inch.

4. Acid Cleaning: After abrasive blasting, clean surfaces with a 5 to 10 percent concentration of hydrochloric acid wash. Thoroughly neutralize and flush acid from finished surfaces with water under pressure. Protect casting slab and adjacent panels from acid wash.

3.9 FACE-DOWN FINISHES

A. Face-Down finishes to match adjacent existing panels (as provided by ATMI Precast).

B. Smooth, As-Cast Finish: Cast panel to produce a surface free of pockets, sand streaks, and honeycombs. Produce a surface appearance of uniform color and texture.

C. Form-Liner Finish: Cast panel over form liners placed, secured, and sealed over casting slab to produce a textured surface free of pockets, streaks, and honeycombs. Produce a surface appearance of uniform color and texture.

D. Abrasive-Blast, Exposed-Aggregate Finish: Produce exposed-aggregate finish to exterior surface of concrete by abrasive blasting after panel erection.

1. Apply abrasive-blast finish using abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces as follows:

a. Light Exposure: Expose fine aggregate with occasional exposure of coarse aggregate and uniform color; maximum reveal of 1/16 inch.
b. Medium Exposure: Generally expose coarse aggregate with slight reveal; maximum reveal of 1/4 inch.
c. Heavy Exposure: Expose and reveal coarse aggregate to a maximum projection of one-third of its diameter; reveal of 1/4 to 1/2 inch.

E. Brushed Exposed-Aggregate Finish: Produce exposed-aggregate finish to exterior surface of concrete by washing and brushing after panel erection, as follows:

1. After panel erection and without dislodging aggregate, remove excess mortar by lightly brushing surface with stiff nylon-bristle broom.
2. Fine spray surface with water, and brush. Repeat water flushing and brushing cycle until cement film is removed from aggregate surfaces to depth required.

F. Bushhammer Exposed-Aggregate Finish: Allow concrete to cure at least 14 days before starting bushhammer surface finish operations.

1. Surface Continuity: Perform bushhammer finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work. Maintain required patterns or variances of cut as shown on Drawings or to match mockup.
2. Surface Cut: Maintain required depth of cut and general aggregate exposure. Use power tool with bushhammer attachments for large, flat surfaces, and use hand hammers for small areas, at corners and edges, and for restricted locations where power tools cannot reach.

G. Sand-Bed, Exposed-Aggregate Finish: Place selected exposed aggregate on a sand bed over casting slab before placing reinforcement, embedments, and concrete. After erecting panel, remove sand to expose aggregate.

3.10 CONCRETE PROTECTING AND CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures according to ACI 301.

1. Apply evaporation retarder in hot, dry, or windy weather to protect concrete from rapid moisture loss before and during finishing operations. Apply according to manufacturer's written instructions after screeding and bull floating concrete, but before float finishing.

B. Begin curing immediately after finishing concrete. Cure by one or a combination of the following methods according to ACI 308.1:

1. Moisture Curing: Keep surfaces continuously moist for no fewer than seven days with the following materials:

a. Water.
b. Continuous water-fog spray.

c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for no fewer than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.11 ERECTION

A. Use erection equipment with care to prevent damage to floor slabs and panels.

B. Lift, support, and erect panels only at designated lifting or supporting points indicated on Shop Drawings.

C. Do not erect panels until 75 percent of 28-day compressive strength of concrete has been verified.

D. Do not erect panels until verified compressive strength of concrete exceeds [**2500 psi**] <**Insert value**>.

E. Install tilt-up concrete panels level, plumb, square, and true. Place panels on leveled grout-setting pads or shims in correct position. Maintain joint width between panels as recommended by manufacturer.

1. Install tilt-up concrete panels with face-down surfaces exposed to exterior of building.

F. Temporarily brace and support panels securely in position against loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to panels are secured.

G. Anchor panels in place and, if indicated, to one another.

1. Weld steel connectors to steel supports and embedments indicated, complying with AWS D1.1/D1.1M.

H. Solidly grout-fill gaps between foundation system and bottom of panels.

3.12 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before erection of tilt-up panels.

D. Testing Services: Tests shall be performed according to ACI 301.

E. Tilt-up concrete panels will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.13 ERECTION TOLERANCES

A. Install tilt-up concrete panels without exceeding the following erection tolerances:

1. Joint Width Variation (Exterior Face): Without decreasing or increasing more than 50 percent from specified joint width, maintain joint width as follows:

   a. For Panels up to 20 Feet Tall: 1/4 inch.
   b. Each Additional 10 Feet in Excess of 20 Feet Tall: 1/8 inch.

2. Joint Taper: Maximum 3/8 inch over length, but not greater than the following:

   a. For Panels up to 20 Feet Tall: 1/4 inch.
   b. Each Additional 10 Feet in Excess of 20 Feet Tall: 1/8 inch.

3. Panel Alignment:

   a. Alignment of Horizontal and Vertical Joints: 1/4 inch.
   b. Offset in Exterior Face of Adjacent Panels: 1/4 inch.

3.14 FILLING AND REPAIR

A. Patch holes and voids left by erecting and bracing inserts on tilt-up panels and slabs-on-grade. Cut or chip edges of voids perpendicular to concrete surface. Fill blockouts where indicated.

1. Clean, dampen with water, and brush-coat holes, voids, and blockouts with bonding agent. Fill and compact with patching mortar of a stiff consistency before bonding agent has dried.
2. Finish surfaces of fills and repairs to Architect's approval, with materials of same colors and textures as finishes on surrounding surfaces.

B. Repair damaged galvanized-steel surfaces of connectors by cleaning and applying a coat of zinc repair paint.

C. Repair damage to tilt-up panels and slabs-on-grade resulting from tilt-up work, as directed by Architect.

D. Remove and replace tilt-up panels that do not comply with requirements in this Section.

E. Demolish and remove temporary concrete casting slabs.

END OF SECTION 034713

SECTION 042000 - UNIT MASONRY

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 unit masonry assemblies consisting of the following:

1. Concrete masonry units (CMUs).
2. Mortar and grout.
3. Reinforcing steel.
4. Masonry joint reinforcement.
5. Ties and anchors.
6. Miscellaneous masonry accessories.

B. Related Sections include the following:

1. Division 07 Section "Penetration Firestopping" for firestopping at openings in masonry walls.
2. Division 07 Section "Joint Sealants" for sealing control and expansion joints in unit masonry.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

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

B. Samples: Provide samples of exposed CMU.

C. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:

1. Masonry units.

a. Include material test reports substantiating compliance with requirements.

2. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
3. Grout mixes. Include description of type and proportions of ingredients.

4. Anchors, ties, and metal accessories.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for 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 a single manufacturer for each cementitious component and from one source or producer for each aggregate.

D. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

E. Prior to commencement of steel erection, contractor must provide the steel erector written notification that the mortar in the masonry piers and walls has attained either 75 percent of the intended minimum compressive design strength or sufficient strength to support the loads imposed during steel erection.

1.6 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. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

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

1.7 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of exterior walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
2. Where 1 wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

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 spreading coverings 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.

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 ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

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 Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. 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.

2.2 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 uses 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.

2.3 CONCRETE MASONRY UNITS (CMUs)

A. Shapes: Provide shapes indicated and as follows:

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide bullnose units for outside corners at interior walls, unless otherwise indicated.

B. Concrete Masonry Units: ASTM C 90 Type I.
1. Unit Compressive Strength: Provide units with a minimum average net-area compressive strength of 1500 psi at 28 days.
2. Weight Classification: Normal weight below grade and light weight or normal weight units above grade, unless otherwise indicated.
3. Provide Type I, moisture controlled units.
4. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.

2.4 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I. Provide natural color or white cement as required to produce mortar color indicated.

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

C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I and hydrated lime complying with ASTM C 207, Type S.

D. Mortar Cement: ASTM C 1329.

1. Available Products:

a. Lafarge North America Inc.; Lafarge Mortar Cement or Magnolia Superbond Mortar Cement.

E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.

1. Available Products:

a. Bayer Corporation, Industrial Chemicals Div.; Bayferrox Iron Oxide Pigments.
b. Davis Colors; True Tone Mortar Colors.
c. Solomon Grind-Chem Services, Inc.; SGS Mortar Colors.

F. Colored Cement Product: Packaged blend made from portland cement and lime, masonry cement or mortar cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
2. Pigments shall not exceed 10 percent of portland cement by weight.
3. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
4. Available Products:

    a. Colored Portland Cement-Lime Mix:

        1) Capital Materials Corporation; Riverton Portland Cement Lime Custom Color.
        2) Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
        3) Lafarge North America Inc.; Eaglebond.
        4) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.

    b. Colored Masonry Cement:

        1) Capital Materials Corporation; Flamingo Color Masonry Cement.
        2) Essroc, Italcementi Group; Brixment-in-Color.
        3) Holcim (US) Inc.; Rainbow Mortamix Custom Color Masonry Cement.
        4) Lafarge North America Inc.; Florida Custom Color Masonry or Magnolia Masonry Cement.
        5) Lehigh Cement Company; Lehigh Custom Color Masonry Cement.
        6) National Cement Company, Inc.; Coosa Masonry Cement.

    c. Colored Mortar Cement:

        1) Lafarge North America Inc.; Magnolia Superbond Mortar Cement.

G. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

H. Aggregate for Grout: ASTM C 404.

I. Cold-Weather Admixture: Cold weather admixtures are prohibited unless approved in writing by the Architect. If approved for use, the admixture shall be nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Available Products:

    a. Euclid Chemical Company (The); Accelguard 80.
    b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Morset.
    c. Sonneborn, Div. of ChemRex; Trimix-NCA.

J. Water: Potable.

2.5 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615 or ASTM A 996, Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951.

1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size for Side Rods: W2.8 or 0.188-inch diameter.
4. Wire Size for Cross Rods: W1.7 or 0.148-inch diameter.
5. Wire Size for Veneer Ties: W1.7 or 0.148-inch diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Provide ladder type with single pair of side rods.

2.6 TIES AND ANCHORS

A. General: Use Anchors as indicated on the drawings.

2.7 MISCELLANEOUS ANCHORS

A. Anchor Bolts: Headed or L-shaped 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/A 153M, Class C; of dimensions indicated.

B. Postinstalled Anchors: Provide epoxy adhesive or torque-controlled expansion anchors, with capability to sustain, without failure, a load equal to six times the load imposed when installed in solid or grouted 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. 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).
2. Expansion anchors: expansion anchors shall be the size, and embedment indicated on drawings. Expansion anchors shall be sleeve anchors when embedded into masonry, unless otherwise noted. Install per manufacturer's recommendations. Submit manufacturer's data prior to installation.
3. Epoxy adhesive anchors: submit manufacturer's data for epoxy adhesive prior to installation. Install per manufacturer's recommendations. Threaded rods shall be astm a36. Sizes and embedment as indicated on the drawings.

2.8 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A 240, Type 304, 0.016 inch thick.
2. Copper: ASTM B 370, Temper H00 or H01, cold-rolled copper sheet, 10-oz./sq. ft. weight or 0.0135 inch thick for fully concealed flashing; 16-oz./sq. ft. weight or 0.0216 inch thick elsewhere.

3. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
4. Fabricate through-wall metal flashing embedded in masonry from stainless steel or copper, with ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.

    a. Available Products:

        1) Cheney Flashing Company; Cheney Flashing (Dovetail) or Cheney 3-Way Flashing (Sawtooth).
        2) Keystone Flashing Company, Inc.; Keystone 3-Way Interlocking Thruwall Flashing.

5. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
6. Fabricate through-wall flashing with drip edge, unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees.
7. Fabricate metal drip edges for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam will shed water.
8. Metal Drip Edges: Fabricate from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees.
9. Metal Flashing Terminations: Fabricate from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 3/8 inch to form a stop for retaining sealant backer rod.

B. Flexible Flashing: For flashing not exposed to the exterior, use one of the following, unless otherwise indicated:

1. Copper-Laminated Flashing: 5-oz./sq. ft. copper sheet bonded with asphalt between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

2. Asphalt-Coated Copper Flashing: 5-oz./sq. ft. copper sheet coated with flexible asphalt. Use only where flashing is fully concealed in masonry.

3. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.030 inch.

4. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy as follows:

    a. Monolithic Sheet: Elastomeric thermoplastic flashing, 0.040 inch thick.
    b. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 0.025 inch thick, with a 0.015-inch- thick coating of rubberized-asphalt adhesive.
    c. Self-Adhesive Sheet with Drip Edge: Elastomeric thermoplastic flashing, 0.025 inch thick, with a 0.015-inch- thick coating of rubberized-asphalt adhesive. Where flashing extends to face of masonry, rubberized-asphalt coating is held back approximately 1-1/2 inches from edge.

        1) Color: Gray.

d. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

C. Solder and Sealants for Sheet Metal Flashings:

1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
2. Solder for Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.
3. Elastomeric Sealant: ASTM C 920, chemically curing urethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
4. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.9 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, urethane, or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

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

D. Weep/Vent Products: Use one of the following, unless otherwise indicated:

1. Wicking Material: Absorbent rope, made from cotton or UV-resistant synthetic fiber, 1/4 to 3/8 inch in diameter, in length required to produce 2-inch exposure on exterior and 18 inches in cavity between wythes. Use only for weeps.
2. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8-inch OD by 4 inches long.
3. Rectangular Plastic Weep/Vent Tubing: Clear butyrate, 3/8 by 1-1/2 by 3-1/2 inches long.
4. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.

a. Available Products:

1) Advanced Building Products Inc.; Mortar Maze weep vent.
2) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
3) Heckmann Building Products Inc.; No. 85 Cell Vent.
4) Hohmann & Barnard, Inc.; Quadro-Vent.
5) Wire-Bond; Cell Vent.

5. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.

    a. Available Products:

        1) Mortar Net USA, Ltd.; Mortar Net Weep Vents.

6. Aluminum Weep Hole/Vent: One-piece, L-shaped units made from sheet aluminum, designed to fit into a head joint and consisting of a vertical channel with louvers stamped in web and with a top flap to keep mortar out of the head joint; painted before installation to comply with Division 09 painting Sections in color approved by Architect to match that of mortar.

    a. Available Products:

        1) Hohmann & Barnard, Inc.; #343W - Wilko Weep Hole.

7. Vinyl Weep Hole/Vent: One-piece, offset, T-shaped units made from flexible, injection-molded PVC, designed to fit into a head joint and consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units, and a top flap to keep mortar out of the head joint; in color approved by Architect to match that of mortar.

    a. Available Products:

        1) Hohmann & Barnard, Inc.; #343 Louvered Weep Hole.
        2) Williams Products, Inc.; Williams-Goodco Brick Vent.
        3) Wire-Bond; Louvered Weepholes.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Provide one of the following configurations:

    a. Strips, full-depth of cavity and 10 inches wide, with dovetail shaped notches 7 inches deep that prevent mesh from being clogged with mortar droppings.
    b. Strips, not less than 3/4 inch thick and 10 inches wide, with dimpled surface designed to catch mortar droppings and prevent weep holes from being clogged with mortar.
    c. Sheets or strips full depth of cavity and installed to full height of cavity.
    d. Sheets or strips not less than 3/4 inch thick and installed to full height of cavity with additional strips 4 inches high at weep holes and thick enough to fill entire depth of cavity and prevent weep holes from being clogged with mortar.

2. Available Products:

    a. Advanced Building Products Inc.; Mortar Break or Mortar Break II.
    b. Archovations, Inc.; CavClear Masonry Mat.
    c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
    d. Mortar Net USA, Ltd.; Mortar Net.

2.10 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Available Manufacturers:

a. Diedrich Technologies, Inc.
b. ProSoCo, Inc.

2.11 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type M.
2. For reinforced masonry, use Type S.
3. For non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
4. For interior non-load-bearing partitions, Type O may be used instead of Type N.

D. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M. . Minimum compressive strength = 2000 psi at 28 days.

2.12 SOURCE QUALITY CONTROL

A. Owner will 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. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

B. Concrete Masonry Unit Test: For each type of unit furnished, per 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 of work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

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

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

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

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

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

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

1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
5. 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.

6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

F. Grout all cells below grade, and cells as indicated, solid.

3.3 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: Unless otherwise indicated, lay exposed masonry in bond pattern to match existing masonry in the area of work; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches. 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: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar.

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

F. Fill space between steel 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, wire mesh, or plastic mesh 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 roof structure above, unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. At fire-rated partitions, treat joint between top of partition and underside of structure above with Fire-Resistive Joint Systems.

3.4 MORTAR BEDDING AND JOINTING

A. Lay hollow concrete masonry units as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.

2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint), unless otherwise indicated.

3.5 CAVITY WALLS

A. Bond wythes of cavity walls together using bonding system indicated on Drawings.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

A. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

B. Install air barrier as indicated on cavity face of backup wythe.

C. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.6 MASONRY JOINT REINFORCEMENT

A. General: 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.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 24 inches beyond openings.

    a. Reinforcement above is in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:

1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

C. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section "Joint Sealants," but not less than 3/8 inch.

1. Locate horizontal, pressure-relieving joints beneath shelf angles and lintels supporting masonry.

3.8 LINTELS

A. Install steel lintels where indicated.

B. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

C. Unless noted otherwise on plans, under lintels, bearing plates, beams, etc.; fill cells with grout, 3 courses minimum below bearing.

3.9 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows, unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 4 inches, and 1-1/2 inches into the inner wythe.
3. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under building paper or building wrap, lapping at least 4 inches.
4. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
5. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Division 07 Section "Joint Sealants" for application indicated.
6. Install metal drip edges with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Division 07 Section "Joint Sealants" for application indicated.
7. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
8. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
9. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

D. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:

1. Use specified weep/vent products to form weep holes.
2. Use wicking material to form weep holes above flashing under masonry sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
3. Space weep holes 24 inches o.c., unless otherwise indicated.
4. Space weep holes formed from plastic tubing or wicking material 16 inches o.c.
5. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
6. Trim wicking material flush with outside face of wall after mortar has set.

E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article.

3.10 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

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

1. All reinforcing steel shall be supported and fastened to approved positioners located at 192 bar diameters maximum spacing and with a minimum of two positioners per grout pour (one near the bottom and one near the top) to prevent displacement during the placement of grout.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.11 FIELD QUALITY CONTROL

A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.

1. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.

3.12 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, where indicated.

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 nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.

4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.13 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Division 31 Section "Earthwork."
3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Structural steel.
2. Grout.

B. Related Requirements:

1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
2. Section 053100 "Steel Decking" for field installation of shear connectors through deck.
3. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame miscellaneous steel fabrications and other steel items not defined as structural steel.

1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Heavy Sections: Rolled and built-up sections as follows:

1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches.
2. Welded built-up members with plates thicker than 2 inches.
3. Column base plates thicker than 2 inches.

1.4 COORDINATION

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

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

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Laboratory Test Reports for Credit IEQ 4.2: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

D. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, professional engineer, and testing agency.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers.
6. Nonshrink grout.

F. Survey of existing conditions.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 360.
3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated and AISC 360.
2. Use Load and Resistance Factor Design; data are given at factored-load level.

B. Moment Connections: Type FR, fully restrained.

C. Construction: Shear wall system.

2.2 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. W-Shapes: ASTM A 992/A 992M.

C. Channels, Angles: ASTM A 36/A 36M.

D. Plate and Bar: ASTM A 36/A 36M.

E. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588/A 588M, Grade 50.

F. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing.

G. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.

1. Weight Class: As indicated.
2. Finish: Black except where indicated to be galvanized.

H. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A 563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 490, compressible-washer type with plain finish.

C. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating.
2. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with mechanically deposited zinc coating finish.

D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain.

E. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

F. Unheaded Anchor Rods: ASTM F 1554, Grade 36.

1. Configuration: Straight.
2. Nuts: ASTM A 563 heavy-hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436, Type 1, hardened carbon steel.
5. Finish: Plain.

G. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436, Type 1, hardened carbon steel.
4. Finish: Plain.

H. Threaded Rods: ASTM A 36/A 36M.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Washers: ASTM A 36/A 36M carbon steel.
3. Finish: Plain.

2.4 PRIMER

A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

C. Galvanizing Repair Paint: ASTM A 780/A 780M.

2.5 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning."

F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

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

2.8 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.
6. Surfaces enclosed in interior construction.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
1. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

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

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and

loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened, unless otherwise noted.

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

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION 05 12 00

SECTION 052100 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. K-series steel joists.
2. KCS-type K-series steel joists.
3. Joist accessories.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing bearing plates in concrete.
2. Section 051200 "Structural Steel Framing" for field-welded shear connectors.

1.3 DEFINITIONS

A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.4 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Laboratory Test Reports for Credit EQ 4: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.

2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
3. Indicate locations and details of bearing plates to be embedded in other construction.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Welding certificates.

C. Manufacturer certificates.

D. Mill Certificates: For each type of bolt.

E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications**.**

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications**.**

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.8 SEQUENCING

A. Deliver steel bearing plates to be built into cast-in-place concrete construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.

1. Use ASD; data are given at service-load level.

2. Design special joists to withstand design loads with live-load deflections no greater than the following:
   a. Roof Joists: Vertical deflection of 1/240 of the span.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2.2 K-SERIES STEEL JOISTS

A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.

1. Joist Type: K-series steel joists and KCS-type K-series steel joists.

B. Provide holes in chord members for connecting and securing other construction to joists.

C. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."

D. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."

E. Do not camber joists.

F. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.3 PRIMERS

A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.4 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. Fabricate steel bearing plates from ASTM A 36/A 36M steel with integral anchorages of sizes and thicknesses indicated. Shop prime paint.

C. Steel bearing plates with integral anchorages are specified in Section 055000 "Metal Fabrications."

D. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated.

E. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.

1. Finish: Plain, uncoated.

F. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

1. Finish: Plain.

G. Welding Electrodes: Comply with AWS standards.

H. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.5 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by power-tool cleaning, SSPC-SP 3.

B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.

C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing 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 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications**,** joist manufacturer's written recommendations, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.

3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.

C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using carbon-steel bolts.

E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with Research Council on Structural Connection's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.

F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.

B. Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, as applicable:

    a. Liquid Penetrant Inspection: ASTM E 165.
    b. Magnetic Particle Inspection: ASTM E 709.
    c. Ultrasonic Testing: ASTM E 164.
    d. Radiographic Testing: ASTM E 94.

C. Visually inspect bolted connections.

D. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.

E. Perform additional testing to determine compliance of corrected Work with specified requirements.

3.4 PROTECTION

A. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.

1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.
2. Apply a compatible primer of same type as primer used on adjacent surfaces.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION 052100

SECTION 053100 - STEEL DECKING

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. Roof deck.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
3. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Laboratory Test Reports for Credit EQ 4: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.

D. Evaluation Reports: For steel deck.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2.2 ROOF DECK

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. Canam United States; Canam Group Inc.

2. CMC Joist & Deck.
3. Consolidated Systems, Inc.; Metal Dek Group.
4. Epic Metals Corporation.
5. New Millennium Building Systems, LLC.
6. Nucor Corp.; Vulcraft Group.
7. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.

2. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G60 zinc coating.
3. Deck Profile: As indicated.
4. Profile Depth: As indicated.
5. Design Uncoated-Steel Thickness: As indicated.
6. Span Condition: Triple span or more.
7. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

I. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

J. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch-wide flanges and sloped recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.

K. Galvanizing Repair Paint: ASTM A 780.

L. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions 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 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:

1. Weld Diameter: 5/8 inch, nominal.
2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports as indicated

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 4 inches minimum.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one fastener at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Mechanically fasten to substrate to provide a complete deck installation.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FLOOR-DECK INSTALLATION

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

1. Weld Diameter: 5/8 inch, nominal.
2. Weld Spacing: Space as indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports as indicated.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Butted.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.

1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

END OF SECTION 05 31 00

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Exterior non-load-bearing wall framing.

B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for masonry shelf angles and connections.
2. Division 09 Section "Gypsum Board Assemblies" for interior non-load-bearing, metal-stud-framed, wall assemblies.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated**.**
2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:

    a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the framing member span length.
    b. Exterior Non-Load-Bearing Framing with Brick: Horizontal deflection of l/600 of the framing member span length.
    c. Interior Non-Load Bearing Framing: Horizontal deflection of l/360 of the framing member span length.

3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

    a. Upward and downward movement of 1 inch.

B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."

1. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.4 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings: Show layout, spacing, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners type and location, weld lengths and locations and other fastener requirements. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work. Show cross sections, plans and/or elevations depicting component size and location.

a. Shop drawing approval is required prior to fabrication and erection. Shop drawings shall bear the designer/qualified professional engineer's Ohio seal.

b. Include structural analysis data for exterior non-loading bearing wall framing and connections, signed and sealed by the qualified professional engineer responsible for their preparation. Calculations should include, but are not limited to:
   1) Description of design criteria.
   2) Engineering analysis depicting stress and deflection (stiffness) requirements for each framing application.
   3) Selection of framing components and accessories.
   4) Verification of attachments to structure and/or adjacent framing components.

C. Welding certificates.

D. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

1.5 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering

services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated.

D. Product Tests: Mill certificates or data from a qualified independent testing agency**,** or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.

E. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

F. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

G. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

H. Comply with AISI's "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing by one of the following:

1. Clark Steel Framing Industries.
2. Dale Industries, Inc.
3. Dietrich Industries, Inc.
4. MarinoWare; Div. of Ware Industries, Inc.
5. The Steel Network, Inc.

2.2 MATERIALS

A. Steel Sheet: ASTM A 653, structural steel, Grade 33 for members 18 gage and lighter, Grade 50 for members 16 gage and heavier, G60 zinc coating (unless noted otherwise on drawings).

B. Steel Sheet for Vertical Deflection and Drift Clips: ASTM A 653, structural steel, zinc coated, of grade and coating as follows:

1. Grade: 50, Class 1 or 2.
2. Coating: G90.

2.3 EXTERIOR AND INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, complying with ASTM A1003 and ASTM C955, and as follows:

1. Minimum Base-Metal Thickness: As required to withstand design loads but not less than 43 mils (18 gage).
2. Flange Width: 1-5/8 inches.
3. Framing members 54 mils (16 gage) and heaver, Fy=50 ksi minimum. Framing members 43 mils (18 gage) and lighter, Fy=33 ksi minimum. All studs to be G60 galvanized coating.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, complying with ASTM A1003 and ASTM C955, and as follows:

1. Minimum Base-Metal Thickness: As required to withstand design loads.
2. Flange Width: 1-1/2 inches.

C. Self-Drilling Tapping Screw Fasteners
1. In compliance with SAE J78, size and spacing as noted on drawings.
2. Unless noted otherwise, screws in steel to steel connections shall have a minimum edge distance and spacing of 3 times the nominal screw diameter
3. Screws along the edges of wall sheathing shall be placed a minimum of 3/8” from the sheathing edges
4. Screws shall be of sufficient length to extend through the steel connection a minimum of 3 exposed threads and shall penetrate individual components of connections without causing permanent separation between components.

D. Vertical Bypass Slide Clips for Non Load-bearing Walls: Verticlip SLB, 68 mils (14 gage) min., 50 ksi, manufactured by The Steel Network, Inc. Install per manufacturer’s recommendations. Substitutes may be considered, submit manufacturer’s data prior to installation.

1. Clips supplied with manufacturer’s standard screws and step bushings.
2. Clips sizes to match stud width.
3. Connect all slide clips to structural steel framing with a minimum (2) powder driven fasteners (Type X-U nail, 0.157” diameter, qualified per ICC-ES ESR-2269) or (2) #12 self drilling fasteners. Connection to light gage members per manufacturer’s recommendations
4. Connection of all slide clips at exterior non load-bearing walls to pour stops or bent plates at floors shall be made with self drilling fasteners as stated above or by welding. Do not use powder driven fasteners to fasten slide clips to pour stops or bent plates.

E. Moment Clips: Stiffclip CL 118 mil (10 gage) manufactured by the Steel Network, Inc. Install per manufacturer's recommendations. Substitutes may be considered, submit manufacturer's data prior to installation:

1. Clips supplied with manufacturer's standard screws and step bushings.
2. Clips sizes to match stud width.
3. Connect all moment clips to structural steel framing with a minimum (2) powder driven fasteners (Type X-U nail, 0.157" diameter, qualified per ICC-ES ESR-2269) or (2) #12 self drilling fasteners. Locate fasteners in outer predrilled holes provided by manufacturer of moment clip
4. Connect all moment clips to concrete with (1) 3/8" diameter Hilti Kwik bolt ii with 4¼" minimum embedment. Install expansion bolt per manufacturer's recommendations

F. Stud Clips for Non Load-bearing Walls: Stiffclip LB series, 68 mils (14 gage) min., 50 ksi, manufactured by the Steel Network, Inc.. Install per manufacturer's recommendations. Substitutes may be considered, submit manufacturer's data prior to installation.

1. Clips supplied with manufacturer's standard screws and step bushings.
2. Clips sizes to match stud width.
3. Connect all stud clips to structural steel framing with a minimum (2) powder driven fasteners (Type X-U nail, 0.157" diameter, qualified per ICC-ES ESR-2269) or (2) #12 self drilling fasteners. Connection to light gage members per manufacturer's recommendations

G. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: As required to withstand design loads.
2. Flange Width: 1 inch (25 mm) plus the design gap for 1-story structures and 1 inch (25 mm) plus twice the design gap for other applications.

2.4 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories of the same material and finish used for framing members, with a minimum yield strength of 33,000 psi.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

2.5 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36, zinc coated by hot-dip process according to ASTM A 123

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

D. Welding Electrodes: Comply with AWS standards.

E. Power Driven Fasteners
1. Power driven fasteners shall be manufactured by Hilti and installed at the spacing shown on the drawings. Install per manufacturers recommendations. Substitutes may be considered; submit manufacturer's data prior to installation. Provide fasteners for steel and concrete substrates as follows:
   a. For fastening light gage metal framing to steel: Type X-U nail, 0.157" diameter, qualified per ICC-ES ESR-2269. Fastener length shall be as required for minimum shank penetration through steel.
   b. For fastening light gage metal framing to concrete: Type X-U nail, 0.157" diameter, 1-1/4" minimum embedment, qualified per ICC-ES ESR-2269.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A 780.

B. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

2.7 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

   a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.

4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

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

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Grout bearing surfaces uniform and level to ensure full contact of bearing flanges or track webs on supporting concrete or masonry construction.

3.3 INSTALLATION, GENERAL

A. Prior to the start of installation of metal framing systems, meet at the project site with the installers of other work, including door and window frames, mechanical, structural, and electrical work. Review areas of potential interference and conflicts and coordinate layout and support provisions for interacting work.

B. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

C. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

D. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

E. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

F. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

G. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

H. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

I. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

J. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

K. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated.

C. Fasten each stud at each floor level, horizontal girt, and roof level, unless noted otherwise on drawings.

D. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

E. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
   1. Connect vertical deflection clips to bypassing studs and anchor to building structure.

F. Install cold-rolled steel channel horizontal bridging (minimum 1 ½" channel) in wall studs, spaced in rows indicated on Shop Drawings but not more than indicated in the following: For walls up to 10 feet in height, install one row of bridging at mid-height. For walls over 10 feet in height, install bridging spaced at 5'-0" on center maximum. Weld or mechanically fasten to web of each punched stud with minimum 1 ½" x 2" x 16 gage clip angle.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.5 FIELD QUALITY CONTROL

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

B. Field and shop welds will be subject to testing and inspecting. All welded connections shall be made by welders certified for welding members of gage being used per AWS D.1.3-08.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Types of work in this Section include, but are not limited to, metal fabrications for the following:
   1. Rough hardware.
   2. Ladders.
   3. Cast metal nosings, treads and thresholds.
   4. Loose bearing and leveling plates.
   5. Loose steel lintels.
   6. Miscellaneous framing and supports for the following:
      a. Steel dunnage at roof top mechanical equipment.
      b. Applications where framing and supports are not specified in other Sections.
   7. Miscellaneous steel trim.
   8. Shelf and relieving angles.
   9. Metal bar gratings.
   10. Floor plate and supports.
   11. Steel pipe railings.
   12. Steel pipe and bar stock railings and handrails.

B. Products Furnished but not Installed under this Section: Furnish the following items for installation under the designated Sections:
   1. Division 3 Section “Cast-In-Place Concrete”: Nosings; items to be cast into concrete.
   2. Division 4 Section “Unit Masonry”: Loose steel lintels; loose bearing and leveling plates; items to be built into unit masonry.
   3. Division 6 Section “Rough Carpentry”: Rough hardware.

C. Related Work
   1. Division 3 Section “Cast-In-Place Concrete”.
   2. Division 4 Section “Unit Masonry”.
   3. Division 5 Section “Structural Steel”.
   4. Division 6 Section “Rough Carpentry”
   5. Division 8 Section “Overhead Coiling Doors”.
   6. Division 9 Section “Painting”.

1.2 DEFINITIONS:

A. Metal fabrications include items made from shapes, plates, bars, strips, tubes, pipes and castings produced from ferrous or non-ferrous metals as indicated, which are not part of structural steel or other metal systems specified elsewhere

B. Definitions in ASTM E985 for railing-related terms apply to this section.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Engineer, fabricate, and install the following metal fabrications to withstand the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections. Apply each load to produce the maximum stress in each respective component of each metal fabrication.
   1. Handrails Not Serving as Top Rails: Capable of withstanding the following loads applied as indicated:
      a. Concentrated load of 200 pounds applied at any point and in any direction.
      b. Uniform load of 50 pounds per foot applied in any direction.
      c. Concentrated and uniform loads above need not be assumed to act concurrently.
   2. Top Rail of Guardrail Systems: Capable of withstanding the following loads applied as indicated:
      a. Concentrated load of 200 pounds applied at any point and in any direction.
      b. Uniform load of 50 pounds per foot applied horizontally at the required guardrail height and a simultaneous uniform load of 100 pounds per foot applied vertically downward at the top of the guardrail.
      c. Concentrated and uniform loads above need not be assumed to act concurrently.
   3. Infill Area of Guardrail Systems: Capable of withstanding a horizontal concentrated load of 200 pounds applied to a one square foot area at any point in the system including panels, intermediate rails, balusters, or other elements composing the infill area.
      a. Above load need not be assumed to act concurrently with uniform horizontal loads on top rails of railing systems in determining stress on guard.
   4. Treads of Steel Stairs: Capable of withstanding a uniform load of 100 pounds per square foot or a concentrated load of 300 pounds on an area of 4 square inches located in the center of the tread, whichever produces the greater stress.
   5. Platforms of Steel Stairs: Capable of withstanding a uniform load of 100 pounds per square foot.
   6. Heavy Duty Metal Bar Gratings: Capable of withstanding a uniform load of 250 pounds per square foot or a concentrated load of 8000 pounds, whichever produces the greater stress.
   7. Gate Hinges: Of a size and strength adequate to support the weight of the gate and a concentrated load of 300 pounds applied at any point of the gate.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 SUBMITTALS

A. Submit in accordance with Division 1 Section “Submittal Procedures”, manufacturer's specifications, anchor details and installation instructions for products used in miscellaneous metal fabrications, including paint products and grout.

B. Submit shop drawings for fabrication and erection of miscellaneous metal fabrications. Include plans, elevations and details of sections and connections. Show anchorage and accessory items. Provide templates for anchor and bolt installation by others.

C. Delegated Design: Where materials or fabrications are indicated to comply with certain requirements for design loadings, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Engage the services of a Professional Structural Engineer registered to practice in the State in which the Project is located, to prepare complete shop drawings for metal railings and stairs, including their attachments. Structural Engineer shall do a complete analysis of all typical and special conditions and certify conformance to governing laws, the Building Code and Contract Documents. Shop drawings and certification shall bear the Engineer's professional seal.
   1. Fabricator's shop drawings stamped with the Engineer's professional stamp will be acceptable instead of shop drawings actually prepared by the Engineer.

E. Submit 2 sets of representative samples of materials and finished products as may be requested by the Architect.

F. Submit welder certificates signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" article.

G. Submit a notarized certificate of compliance from the galvanizer, with an itemized listing and description of all items that have been hot-dip galvanized, hot-dip galvanized/shop prime painted, and hot-dip galvanized/shop finished.
   1. Submit a laboratory analysis of the zinc bath with the names and percentages of metals.

H. Submit qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project name, addresses, names of Architects and Owners, and other information specified.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Firms experienced in successfully producing metal fabrications similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work.

B. Installer Qualifications: Arrange for installation of metal fabrications specified in this section by same firm that fabricated them.

C. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel," D1.3 "Structural Welding Code - Sheet Steel", and D1.2 "Structural Welding Code - Aluminum."
   1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

D. Engineer Qualifications: Professional engineer licensed to practice in jurisdiction where project is located and experienced in providing engineering services of the kind indicated that have resulted in the successful installation of metal fabrications similar in material, design, and extent to that indicated for this Project.

1.6 PROJECT CONDITIONS

A. Field Measurements: Check by accurate field measurements before fabrication, actual locations of walls and other construction to which metal fabrications must fit; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of Work.

1.7 SEQUENCING AND SCHEDULING

A. Sequence and coordinate installation of wall handrails as follows:
   1. Mount handrails only on completed walls. Do not support handrails temporarily by any means not satisfying structural performance requirements.
   2. Mount handrails only on gypsum board assemblies reinforced to receive anchors, and where the location of concealed anchor plates has been clearly marked for benefit of Installer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Metal Surfaces: For metal fabrications exposed to view upon completion of the Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by reference standards for stretcher-leveled sheet.

B. Ferrous metals:
   1. Steel Plates, Shapes and Bars: ASTM A36.
   2. Rolled Steel Floor Plates: ASTM A786.
   3. Steel Bars for Grating: ASTM A569 or ASTM A36.
   4. Wire Rod for Grating Cross Bars: ASTM A510.
   5. Steel Tubing: Cold-formed, ASTM A500; or hot-rolled, ASTM A501.
   6. Structural Steel Sheet: Hot-rolled, ASTM A570; or cold-rolled ASTM A611, Class 1; of grade required for design loading.
   7. Galvanized Structural Steel Sheet: ASTM A653, of grade required for design loading. Coating designation as indicated, or if not indicated, G90.
   8. Steel Pipe: ASTM A53; Type and grade (if applicable) as selected by fabricator and as required for design loading; black finish unless galvanizing is indicated; standard weight (schedule 40), unless otherwise indicated.
   9. Grey Iron Castings: ASTM A48, Class 30.
   10. Malleable Iron Castings: ASTM A47, grade 32510.
   11. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails unless otherwise indicated.
   12. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A47, or cast steel, ASTM A27. Provide bolts washers and shims as required, hot-dip galvanized, ASTM A153.
   13. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for the metal alloy to be welded.

C. Non-Shrink Non-Metallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107, Grade B or C at a fluid consistency (flow cone) of 20 to 30 seconds. Provide grout specifically recommended by manufacturer for interior and exterior applications.
   1. "Burke Non-Ferrous, Non-Shrink Grout" by The Burke Company, San Mateo, CA or equal.

D. Fasteners: Provide zinc-coated fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade and class required.
   1. Bolts and Nuts: Regular hexagon head type, 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.
   2. Lag Bolts: Square head type, ASME B18.2.1 (ASME B18.2.3.8M).
   3. Machine Screws: Corrosion resistant steel, ASME B18.6.3 (ASME B18.6.7M).
   4. Plain Washers: Round, carbon steel, ASME B18.22.1 (ASME B18.22M).
   5. Lock Washers: Helical spring type carbon steel, ASME B18.21.1 (ASME B18.21.2M).
   6. Drilled-In Expansion Anchors: Expansion anchors complying with Federal Specification FF-S-325, Group VIII (anchors, expansion, [nondrilling]), Type I (internally threaded tubular expansion anchor); and machine bolts complying with Federal Specification FF-B-575, Grade 5.
   7. Epoxy Anchors: Epoxy complying with ASTM C881, Type IV, Grade 3 epoxy; and machine bolts complying with Federal Specification FF-B-575, Grade 5.
      a. Product: "Epcon System" by ITW Ramset/Red Head or equal.
   8. Power Driven Fasteners: Federal Specification FF-P-395 or Federal Specification GGG-D-777. Use when permitted by ANSI A10.3. Follow safety provisions of ANSI A10.3.
   9. Toggle Bolts: Tumble-Wing type, Federal Specification FF-B-588, type, class and style as required.

E. Paint:
   1. Shop Primer for Ferrous Metals: Provide universal modified alkyd primer equal to 37H Chem-Prime H.S. by Tnemec.
   2. Shop Primer for Galvanized Ferrous Metals: Epoxy primer applied at 2.5 to 3.0 mils DFT. Provide one of the following products or equal:
      a. Carboline 190 High Build Epoxy Primer.
      b. DuPont 823 HB.
      c. Tnemec 66 Hi-Build Epoxoline Primer.
   3. Shop Primer and Finish for Galvanized Ferrous Metals: Provide epoxy primer and aliphatic top coat, shop applied by the galvanizer.
   4. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035 or SSPC-Paint-20; one of the following or equal:
      a. Tnemec-Zinc 90-93.
      b. ZRC Cold Galvanizing Compound.
      c. ZiRP; Duncan Galvanizing.
   5. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12 except containing no asbestos fibers.

F. Concrete Fill and Reinforcing Materials:
   1. Concrete Materials and Properties: Comply with requirements of Division 3 Section “Cast-In-Place Concrete”, for normal weight, ready-mix concrete with minimum 28 day compressive strength of 2,500 psi.

2. Nonslip Aggregate Finish: Factory-graded, packaged material containing fused aluminum oxide grits or crushed emery as abrasive aggregate; rust-proof and nonglazing; unaffected by freezing, moisture, or cleaning materials.
3. Reinforcing Bars: ASTM A615, Grade 60, unless otherwise indicated.

2.2 FABRICATION

A. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.

B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
1. 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.
2. Shear and punch metals cleanly and accurately. Remove burrs.
3. Remove sharp or rough areas on exposed traffic surfaces.

C. Thermal Movement: Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the design, fabrication, and installation of installed metal assemblies (including handrails and railings) to prevent buckling, opening up of joints, and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.
1. Temperature Change (Range): 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

D. Weld corners and seams continuously to comply with AWS recommendations and 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 that no roughness shows after finishing and contour of welded surface matches those adjacent.

E. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated Phillips flathead (countersunk) screws and bolts. Locate joints where least conspicuous.

F. Provide for anchorage of type indicated, coordinated with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.

G. 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.

H. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware and similar items.

I. Fabricate joints which will be exposed to weather in a manner to exclude water or provide weep holes where water may accumulate.

2.3 ROUGH HARDWARE

A. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Division 6 Sections.

B. Fabricate items to sizes, shapes and dimensions required. Furnish malleable-iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

2.4 STEEL LADDERS

A. Fabricate ladders for the locations shown, with dimensions, spacings, details and anchorages as indicated. Comply with requirements of ANSI A14.3.
   1. Siderails: Provide 1/2 inch by 2-1/2 inch continuous structural steel flat bar side rails with eased edges, spaced 18 inches apart.
   2. Bar Rungs: Provide 3/4 inch diameter solid structural steel bar rungs, spaced 12 inches on center.

B. Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.

C. Support each ladder at top and bottom and at intermediate points spaced not more than 5 feet on center by means of welded or bolted steel brackets.
   1. Size brackets to support design dead and live loads indicated and to hold centerline of ladder rungs clear of the wall surface by not less than 7 inches.
   2. Extend side rails 42 inches above top rung, and return rails to wall or structure unless other secure handholds are provided. If the adjacent structure does not extend above the top rung, goose-neck the extended rails back to the structure to provide secure ladder access.

D. Provide non-slip surface on top of each rung, either by coating the rung with aluminum oxide granules set in epoxy resin adhesive, or by using a type of manufactured rung which is filled with aluminum oxide grout.

E. Ladders shall meet all the requirements of OSHA, and shall be so certified by the Contractor, prior to installation.

F. Ship's Ladders: Provide ship's ladders where indicated. Fabricate of open type construction with structural steel channel or steel plate stringers, pipe handrails, and open steel grating treads, unless otherwise indicated. Provide all necessary brackets and fittings for installation.

G. Hot-dip galvanize and prime paint all exterior ladders, brackets and fasteners.

2.5 LADDER SAFETY CAGES

A. Fabricate ladder safety cages to comply with ANSI A14.3; assemble by welding or riveting.

B. Primary Hoops: Steel bars, 5/16 inch by 4 inches, for top, bottom, and for cages longer than 20 feet, intermediate hoops spaced not more than 20 feet on centers.

C. Secondary Intermediate Hoops: Steel bars, 5/16 inch by 2 inches, hoops spaced not more than 4 feet on centers. between primary hoops.

D. Vertical Bars: Steel bars, 5/16 inch by 2 inches, secured to each hoop, spaced approximately 9 inches on centers.

E. Fasten assembled safety cage to ladder rails and adjacent construction as indicated.

F. Hot-dip galvanize and prime paint all exterior ladder safety cages, brackets and fasteners.

2.6 CAST METAL NOSINGS, [STAIR TREADS AND THRESHOLDS]

A. Fabricate units of material, sizes, and configurations indicated. If not indicated, provide cast-iron units with integral abrasive finish. Furnish in lengths as required to accurately fit each opening or conditions.
   1. Cast units with an integral abrasive grit consisting of aluminum oxide, silicone carbide, or a combination of both.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal:
   1. American Abrasive Metals Co.
   2. American Mason Safety Tread Co.
   3. American Safety Tread Co., Inc.
   4. Armstrong Products, Inc.
   5. Safe-T-Metal Co., Inc.
   6. Wooster Products Inc.

C. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with the manufacturer.

D. Drill for mechanical anchors with countersunk holes located not more than 4 inches from ends and not more than 12 inches on centers, evenly spaced between ends. Provide closer spacing if recommended by the manufacturer.
   1. Provide 2 rows of holes for units over 5 inches wide, with 2 holes aligned at ends and staggered intermediate holes.

E. Apply black asphaltic coating to concealed bottoms, sides, and edges of cast-iron units set into concrete.

F. Provide a plain surface texture, except where fluted or cross-hatched surfaces are indicated.

2.7 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required.
   1. Hot-dip galvanize after fabrication.

2.8 LOOSE STEEL LINTELS

A. Fabricate loose structural steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated, except as follows:
   1. All lintels indicated to be a part of structural metal framing.
   2. Over metal door bucks in interior partitions with openings less than 3 feet 0 inches.
   3. Where concrete or reinforced masonry block lintels are indicated.

B. Weld adjoining members together where two or more lintels are placed side by side. Drill and tap lintels to receive other work where required. Provide not less than 8 inch bearing at each side of opening.

C. Provide lintels in accordance with the following schedule (one angle for each 4 inch thickness of masonry.)
   1. For openings up to 3 feet 0 inches: 3-1/2 by 3 by 1/4 inch angle with 3-1/2 inch leg vertical.
   2. For openings 3 feet 0 inches to 4 feet 6 inches: 4 by 3-1/2 by 5/16 inch angle with 4 inch leg vertical.
   3. For openings 4 feet 6 inches to 6 feet 0 inches: 5 by 3-1/2 by 5/16 inch angle with 5 inch leg vertical.
   4. For openings 6 feet 0 inches to 8 feet 0 inches: 6 by 3-1/2 by 3/8 inch angle with 6 inch leg vertical.

D. Hot-dip galvanize loose steel lintels.

2.9 MISCELLANEOUS FRAMING AND SUPPORTS

A. Provide steel framing and supports for applications indicated or which are not a part of structural steel framework, as required to complete work. Miscellaneous framing and support items include but are not limited to the following:
   1. Steel angle sill support at elevator doorways.
   2. Ceiling supports for ceiling hung toilet partitions.
   3. Ceiling supports for folding panel partitions.
   4. Steel dunnage at roof top mechanical equipment.
   5. Channel door frames.
   6. Elevator hoist beams and framing.

B. Fabricate units to sizes, shapes, and profiles indicated and required to receive adjacent other construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.

C. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.
   1. Except as otherwise indicated, space anchors 24 inches on centers and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inches by 8 inches long.

D. Engineered Framing System: Provide "Unistrut P1001" channels with accessories as manufactured by Unistrut Corporation, "Power Strut PS200-2T3" as manufactured by Elcen or equal. Provide framing members at 24 inches on centers to support equipment indicated, unless indicated otherwise.

E. Hot-dip galvanize and prime paint units to be installed in exterior walls; prime paint all other units.

2.10 MISCELLANEOUS STEEL TRIM

A. Provide shapes and sizes indicated for profiles shown. Fabricate units from structural steel shapes, plates and steel bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings and anchorages as required for coordination of assembly and installation with other work.
   1. Hot-dip galvanize and prime paint steel trim units to be installed in exterior walls; prime paint all other units.

2.11 SHELF AND RELIEVING ANGLES

A. Provide structural steel shelf and relieving angles of sizes indicated for attachment to concrete framing. Provide slotted holes to receive 3/4 inch bolts, spaced not more than 6 inches from ends and not more than 24 inches on center.

B. For cavity walls, provide vertical channel brackets with anchors, to support shelf/relieving angles from back-up masonry and concrete. Align expansion joints in angles with indicated expansion joints in cavity wall exterior wythe.

C. Furnish wedge-type concrete inserts, complete with fasteners, for attachment of shelf angles to cast-in-place concrete.

D. Hot-dip galvanize shelf and relieving angles.

2.12 STRUCTURAL STEEL DOOR FRAMES FOR OVERHEAD DOORS

A. Fabricate steel door frames from structural shapes and bars of size and to dimensions indicated, fully welded together, with 5/8 inch by 1-1/2 inch steel bar stops, unless otherwise indicated. Plug weld built-up members and continuously weld exposed joints. Secure removable stops to frame with countersunk machine screws, uniformly spaced at not more than 10 inches on centers. Reinforce frames and drill and tap as required to accept finish hardware.

B. Provide steel strap anchors for securing door frames into adjoining concrete or masonry, using 1/8 inch by 2 inch straps of the length required for a minimum 8 inch embedment,

unless otherwise indicated. Weld anchors to frame jambs no more than 12 inches from both bottom and head of frame and space anchors not more than 30 inches apart.

C. Extend bottom of frames to floor elevation indicated with steel angle clips welded to frames for anchoring frame to floor with expansion shields and bolts.

D. Hot-dip galvanize steel door frames to be installed at exterior locations; prime paint all other units.

2.13 METAL BAR GRATINGS

A. Produce metal bar gratings of description indicated per NAAMM marking system that comply with the following:
   1. Metal Bar Grating Standard "Standard Specifications for Metal Bar Grating and Metal Bar Grating Treads" published in ANSI/NAAMM A202.1 "Metal Bar Grating Manual."
   2. Heavy Duty Metal Bar Grating Standard: "Guide Specifications for Heavy Duty Metal Bar Grating" published in NAAMM "Heavy Duty Metal Bar Grating Manual."

B. Fabricate welded steel gratings to comply with requirements indicated below:
   1. Mark/Size: W-19-4 (welded with bearing bars 1-3/16 inch o.c. and cross bars 4 inches o.c.)/bearing bar sizes as indicated.
   2. Mark/Size: W-15-4 (welded with bearing bars 15/16 inch o.c. and cross bars 4 inches o.c.)/bearing bar sizes as indicated.
   3. Mark/Size: As indicated.

C. Fabricate pressure-locked steel gratings to comply with requirements indicated below:
   1. Mark/Size: P-15-4 (pressure-locked with bearing bars 15/16 inch o.c. and cross bars 4 inches o.c.)/bearing bar sizes as indicated.
   2. Mark/Size: P-19-4 (pressure-locked with bearing bars 1-3/16 inch o.c. and cross bars 4 inches o.c.)/bearing bar sizes as indicated.
   3. Mark/Size: As indicated.

D. Fabricate riveted steel gratings to comply with requirements indicated below:
   1. Mark/Size: R-12-7 (riveted with 3/4 inch space between bearing bars and cross bars 7 inches o.c.)/bearing bar sizes as indicated.
   2. Mark/Size: R-18-7 (riveted with 1-1/8 inch space between bearing bars and cross bars 4 inches o.c.)/bearing bar sizes as indicated.
   3. Mark/Size: As indicated.

E. Fabricate pressure-locked rectangular bar aluminum gratings to comply with requirements indicated below:
   1. Mark/Size: P-7-4 (pressure-locked with bearing bars 7/16 inch o.c. and cross bars 4 inches o.c.)/rectangular bearing bar sizes as indicated.
   2. Mark/Size: P-15-4 (pressure-locked with bearing bars 15/16 inch o.c. and cross bars 4 inches o.c.)/rectangular bearing bar sizes as indicated.
   3. Mark/Size: P-19-4 (pressure-locked with bearing bars 1-3/16 inch o.c. and cross bars 4 inches o.c.)/rectangular bearing bar sizes as indicated.
   4. Mark/Size: As indicated.

F. Fabricate pressure-locked I-bar aluminum gratings to comply with requirements indicated below:

1. Mark/Size: P-16-2 (pressure-locked with bearing bars one inch o.c. and cross bars 2 inches o.c.)/I-shaped bearing bar sizes as indicated.
2. Mark/Size: P-19-4 (pressure-locked with bearing bars 1-3/16 inch o.c. and cross bars 4 inches o.c.)/I-shaped bearing bar sizes as indicated.
3. Mark/Size: As indicated.

G. Fabricate welded heavy duty steel gratings to comply with requirements indicated below:
1. Mark/Size: W-19-4 (welded with bearing bars 1-3/16 inch o.c. and cross bars 4 inches o.c.)/bearing bar sizes as indicated, but not less than required to comply with structural performance requirements.
2. Mark/Size: W-30-4 (welded with bearing bars 1-7/8 inch o.c. and cross bars 4 inches o.c.)/bearing bar sizes as indicated, but not less than that required to comply with structural performance requirements.
3. Mark/Size: As indicated.

H. Fabricate pressure-locked, heavy duty stainless steel gratings to comply with requirements indicated below:
1. Mark/Size: P-38-4 (riveted with bearing bars spaced 2-3/8 inches o.c. and cross bars 4 inches o.c.)/bearing bar sizes as indicated, but not less than that required to comply with structural performance requirements.
2. Mark/Size: As indicated.

I. Fabricate riveted heavy duty steel gratings to comply with requirements indicated below:
1. Mark/Size: R-19-3-1/2 (riveted with 1-3/16 inch space between bearing bars and cross bars 3-1/2 inches o.c.)/bearing bar sizes as indicated, but not less than that required to comply with structural performance requirements.
2. Mark/Size: As indicated.

J. Traffic Surface for Steel Bar Gratings: As follows:
1. Plain.
2. Serrated.
3. Knurled.
4. Applied abrasive finish consisting of aluminum oxide aggregate in an epoxy resin adhesive.
5. As indicated.

K. Traffic Surface for Aluminum Bar Gratings: As follows:
1. Plain.
2. Grooved.
3. Applied abrasive finish consisting of aluminum oxide aggregate in an epoxy resin adhesive.
4. As indicated.

L. Steel Finish: As follows:
1. Shop prime paint applied in accordance with manufacturer's standard practice.
2. Hot-dip galvanize with a coating weight of not less than 1.8 oz. per square foot of coated surface and epoxy prime paint.

M. Aluminum Finish:
1. Mill.
2. Class I clear anodized finish.

N. Fabricate removable grating sections with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated, or if not indicated, as recommended by manufacturer, for attachment to supports.
   1. Provide not less than 4 anchors blocks for each section of heavy duty grating composed of bearing bars over 3/16 inch in thickness, with each block shop-welded to 2 bearing bars.
   2. Provide not less than 4 saddle clips for each grating section composed of rectangular bearing bars 3/16 inch or less in thickness and spaced not less than 15/16 inch o.c., with each clip designed and fabricated to fit over 2 bearing bars.
   3. Provide not less than 4 flange blocks for each section of aluminum I-bar grating, with block designed to fit over lower flange of I-shaped bearing bars.
   4. Furnish threaded bolts with nuts and washers for each clip required.
   5. Furnish self-drilling fasteners with washers for each clip required.

O. Attach toe plates to grating by welding, unless otherwise indicated.

P. Furnish toe plates for attachment in field.
   1. Toe plate height: 4 inches, unless a greater height indicated.

Q. Fabricate cutouts in grating sections for penetrations indicated. Arrange layout of cutouts to permit grating removal without disturbing items penetrating gratings.

R. Edge band openings in grating that interrupt 4 or more bearing bars with bars of same size and material as bearing bars.
   1. Do not notch bearing bars at supports to maintain elevation.

S. Manufacturers: Subject to compliance with requirements, provide metal bar gratings by one of the following:
   1. Alabama Metal Industries Corp.
   2. Barnett/Bates Corp.
   3. Blaw-Knox Grating Div., Blaw-Knox Corp.
   4. IKG Industries.
   5. Klemp Corp.
   6. Ohio Gratings, Inc.
   7. Reliance Steel Products, Inc.
   8. Seidelhuber Metal Products, Inc.
   9. Trueweld, Inc.

2.14 STEEL PIPE RAILINGS AND HANDRAILS

A. Fabricate pipe railings and handrails to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of pipe, post spacings, and anchorage, but not less than that required to support structural loads.

B. Interconnect railing and handrail members by butt-welding or welding with internal connectors, at fabricator's option, unless otherwise indicated.
   1. At tee and cross intersections, notch ends of intersecting members to fit contour of pipe to which end is joined and weld all around.

C. Form changes in direction of railing members as follows:

   1. By radius bends of radius indicated.

D. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross-section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.

E. Provide wall returns at ends of wall-mounted handrails.

F. Close exposed ends of pipe by welding 3/16 inch thick steel plate in place or by use of prefabricated fittings, except where clearance of end of pipe and adjoining wall surface is 1/4 inch or less.

G. Toe Boards: Unless otherwise indicated, provide toe boards at railings around openings and at the edge of open-sided floors and platforms. Fabricate to dimensions and details indicated, or if not indicated, use 4 inches high by 1/8 inch steel plate welded to, and centered between, each railing post.

H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnections of pipe and attachment of railings and handrails to other work. Furnish inserts and other anchorage devices for connecting railings and handrails to concrete or masonry work.
   1. For railing posts set in concrete, fabricate sleeves from steel pipe not less than 6 inches long and with an inside diameter not less than 1/2 inch greater than the outside diameter of post, with steel plate closure welded to bottom of sleeve.
      a. Provide friction fit, removable covers designed to keep sleeves clean and hold top edge of sleeve 1/2 inch below finished surface of concrete.
   2. For removable railing posts, fabricate slip-fit sockets from steel pipe whose inside diameter is sized for a close fit with posts and to limit deflection of post without lateral load, measured at top, to not more than 1/12 of post height. Provide socket covers designed and fabricated to resist accidental dislodgement.

I. Fillers: Provide steel sheet or plate fillers of thickness and size indicated or required to support structural loads of handrails where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses. Size fillers to produce adequate bearing to prevent bracket rotation and overstressing of substrate.

J. For exterior steel railings and handrails
   1. For other exterior railings: form from steel pipe and shapes with galvanized finish, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
   2. Hot-dip galvanize and prime paint exterior pipe railings, handrails, infills, brackets, flanges, sleeves and fasteners.

K. For interior steel railings formed from steel pipe with black finish, provide non-galvanized ferrous metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

2.15 FINISHES, GENERAL

A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.

B. Finish metal fabrications after assembly.

2.16 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize all ferrous metal items exposed to the weather or on the exterior of the building using an enhanced galvanizing process including state of the art Quality Assurance/Quality Control methods. The hot-dip galvanized coating shall consist of zinc and other metals ("Deltagalv" by Duncan Galvanizing or equal). Use the "dry kettle" process to prevent flux inclusions or entrapment. Use of a flux blanket on the surface of the galvanizing bath is not acceptable. Provide hot-dip galvanized coating for those items indicated or specified to be galvanized, as follows:
   1. ASTM A153 for Galvanizing Iron And Steel Hardware.
   2. ASTM A123 for Galvanizing Both Fabricated And Unfabricated Iron And Steel Products Made Of Uncoated Rolled, Pressed, And Forged Shapes, Plates, Bars, And Strip 0.0299 Inch Thick And Heavier.
   3. ASTM A384 for Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
   4. ASTM A385 for Standard Practice for Providing High Quality Zinc Coatings (Hot-dip).
   5. ASTM A386 for Galvanizing Assembled Steel Products.

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-SP6 "Commercial Blast Cleaning."
   2. Interiors (SSPC Zone 1A): SSPC-SP3 "Power Tool Cleaning."

C. Shop Priming and Shop Finishing:
   1. Shop Priming Non-Galvanized Metals: Apply shop primer to all surfaces of metal fabrication items except those which are indicated to be embedded in concrete or masonry. Comply with requirements of SSPC-PAL "Paint Application Specification No. 1" for shop painting.
      a. Stripe paint all edges, corners, crevices, bolts, welds, and sharp edges.
   2. Shop Priming Galvanized Metals: Within 12 hours after galvanizing ferrous metals, apply epoxy primer at 2.5 to 3.0 mils DFT, shop applied by the galvanizer ("Primergalv" by Duncan Galvanizing or equal).
   3. Shop Finishing:
      a. For galvanized metal items indicated to be shop finished, apply epoxy primer specified above and apply top coat of aliphatic urethane at 2.5 to 3.0 mils DFT, shop applied by the galvanizer ("Colorgalv" by Duncan Galvanizing or equal).
      b. For non-galvanized metal items indicated to be shop finished, shop primer specified above and apply top coat of paint finish specified in Division 9 Section “Painting and Coating”.

2.17 ALUMINUM FINISHES

A. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.

B. As Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

C. Class I Clear Anodized Finish: AA-M12C22A41 (Mechanical Finish: as fabricated, nonspecular; Chemical Finish: etched, medium matte; Anodic Coating: Class I Architectural, clear film thicker than 0.7 mil) complying with AAMA 607.1.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

B. Center nosings on tread widths with noses flush with riser faces and tread surfaces.

C. Set sleeves in concrete with tops flush with finish surface elevations; protect sleeves from water and concrete entry.

3.2 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous 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 as required.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications. Set metal fabrication 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 the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

E. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and 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 that no roughness shows after finishing and contour of welded surface matches those adjacent.

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 or zinc chromate primer.

3.3 SETTING LOOSE PLATES

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

B. Set loose leveling and bearing plates on wedges, or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout.
   1. Use metallic nonshrink grout in concealed locations where not exposed to moisture; use nonmetallic nonshrink grout in exposed locations, unless otherwise indicated.

C. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 INSTALLATION OF METAL BAR GRATINGS

A. Install gratings to comply with recommendations of NAAMM grating standard referenced under Part 2 that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Secure 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. Secure nonremovable units to supporting members by welding where both materials are the same; otherwise, fasten by bolting as indicated above.

D. Attach toe plates to gratings by welding, at locations indicated.

3.5 INSTALLATION OF STEEL PIPE RAILINGS AND HANDRAILS

A. Adjust railings prior to anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated, or if not indicated, as required by design loadings. Plumb posts in each direction. Secure posts and railing ends to building construction as follows:
   1. Anchor posts in concrete by means of pipe sleeves preset and anchored into concrete. After posts have been inserted into sleeves, fill annular space between post and sleeve solid with the following anchoring material, mixed and placed to comply with anchoring material manufacturer's directions.
   2. Anchor posts in concrete by core drilling holes not less than 5 inches deep and 3/4 inch greater than outside diameter of post. Clean holes of all loose material, insert posts and fill annular space between post and concrete with the following anchoring material, mixed and placed to comply with anchoring material manufacturer's directions.
      a. Nonshrink, nonmetallic grout.
      b. Nonshrink, nonmetallic grout or anchoring cement.

c. Leave anchorage joint exposed, wipe off surplus anchoring material, and leave 1/8 inch build-up, sloped away from post. For installations exposed on exterior, or to flow of water, seal anchoring material to comply with grout manufacturer's directions.

3. Anchor posts to steel with steel oval flanges, angle type or floor type as required by conditions, welded to posts and bolted to steel supporting members.
4. Anchor rail ends into concrete and masonry with steel round flanges welded to rail ends and anchored into wall construction with lead expansion shields and bolts.
5. Anchor rail ends to steel with steel oval or round flanges welded to rail ends and bolted to structural steel members, unless otherwise indicated.
6. Install removable railing sections where indicated in slip-fit metal sockets cast into concrete. Accurately locate sockets to match post spacing.

B. Secure handrails to wall with wall brackets and end fittings. Provide bracket with not less than 1-1/2 inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated, or if not indicated, at spacing required to support structural loads. Secure wall brackets and wall return fittings to building construction as follows:
1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
2. For concrete and solid masonry anchorage, use drilled-in expansion shield and either concealed hanger bolt or exposed lag bolt, as applicable.
3. For hollow masonry anchorage, use toggle bolts having square heads.
4. For steel framed gypsum board assemblies, fasten brackets directly to steel framing or concealed anchors using self-tapping screws of size and type required to support structural loads.

C. Expansion Joints: Provide expansion joints at locations indicated, or if not indicated, at intervals not to exceed 40 feet. Provide slip joint with internal sleeve extending 2 inches beyond joint on either side; fasten internal sleeve securely to one side; locate joint within 6 inches of post.

D. Gates: Hang gates plumb, level and secure for full opening without interference. Provide gate appurtenances as indicated on the Drawings including but not limited to bottom bolt, support lugs, and center and edge stops for securing gate in open and closed positions. Adjust hardware for smooth operation and lubricate where necessary. No sag or twist will be allowed in gates.

3.6 INSTALLATION OF CAST TREADS AND THRESHOLDS

A. Install cast treads and thresholds with anchorage system indicated to comply with manufacturer's recommendations.

B. Seal thresholds exposed to exterior with elastomeric sealant complying with Division 7 Section "Joint Sealants" to provide a watertight installation.

3.7 ADJUSTING AND CLEANING

A. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touch-up of field painted surfaces.

1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touch-Up Painting: Cleaning and touch-up painting of field welds, bolted connections, and abraded areas of the shop paint on miscellaneous metal is specified in Division 9 Section “Painting and Coating”.

C. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A780.

END OF SECTION 055000

SECTION 061000 - ROUGH CARPENTRY

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. Framing with dimension lumber.
2. Framing with timber.
3. Framing with engineered wood products.
4. Shear wall panels.
5. Rooftop equipment bases and support curbs.
6. Wood blocking and nailers.
7. Wood furring and grounds.
8. Wood sleepers.
9. Utility shelving.
10. Plywood backing panels.

B. Related Requirements:

1. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.
2. Section 062023 “Interior Finish Carpentry”

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. OSB: Oriented strand board.

E. Timber: Lumber of 5 inches nominal size or greater in least dimension.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
4. Shear panels.
5. Power-driven fasteners.
6. Post-installed anchors.
7. Metal framing anchors.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent for 2-inch nominal thickness or less; no limit for more than 2-inch nominal thickness unless otherwise indicated.

C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.

D. Application: Treat items indicated on Drawings, 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, stucco or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Treatment shall not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use only on areas of interior conditioned spaces.
4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841. For enclosed roof framing, framing in attic spaces, and where high temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.

C. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by testing agency.

D. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.

E. Application: Treat items indicated on Drawings, and the following:

1. Framing for raised platforms.
2. Framing for stages.

3. Framing and blocking in areas permitted in buildings of Type 1 & 2 construction
4. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.

1. Application: All interior non-load bearing partitions.
2. Species:

a. Hem-fir (north); NLGA.
b. Southern pine or mixed southern pine; SPIB.
c. Spruce-pine-fir; NLGA.
d. Hem-fir; WCLIB, or WWPA.
e. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
f. Eastern softwoods; NeLMA.

B. Load-Bearing Partitions: No. 2 grade.

1. Application: Exterior walls and interior load-bearing partitions.
2. Species:

a. Hem-fir (north); NLGA.
b. Douglas fir-larch; WCLIB or WWPA.
c. Southern pine or mixed southern pine; SPIB.
d. Spruce-pine-fir; NLGA.
e. Douglas fir-south; WWPA.
f. Hem-fir; WCLIB or WWPA.
g. Douglas fir-larch (north); NLGA.
h. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

C. Ceiling Joists: Construction or No. 2 grade.

1. Species:

a. Hem-fir (north); NLGA.
b. Douglas fir-larch; WCLIB or WWPA.
c. Douglas fir-larch (north); NLGA.
d. Southern pine or mixed southern pine; SPIB.
e. Spruce-pine-fir; NLGA.
f. Hem-fir; WCLIB or WWPA.
g. Douglas fir-south; WWPA.
h. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
i. Eastern softwoods; NeLMA.

D. Joists, Rafters, and Other Framing Not Listed Above: No. 2 grade.

1. Species:

a. Hem-fir (north); NLGA.
b. Southern pine; SPIB.
c. Douglas fir-larch; WCLIB or WWPA.

d. Southern pine or mixed southern pine; SPIB.
e. Spruce-pine-fir; NLGA.
f. Douglas fir-south; WWPA.
g. Hem-fir; WCLIB or WWPA.
h. Douglas fir-larch (north); NLGA.
i. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

E. Exposed Framing Indicated to Receive a Stained or Natural Finish: Hand-select material for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.

1. Species and Grade: As indicated above for load-bearing construction of same type.

2.5 TIMBER FRAMING

A. Comply with the following requirements, according to grading rules of grading agency indicated:

1. Species and Grade: Douglas fir-larch, Douglas fir-larch (north), or Douglas fir-south; [**Select Structural**] [**No. 1**] grade; NLGA, WCLIB, or WWPA.
2. Species and Grade: Eastern hemlock, eastern hemlock-tamarack, or eastern hemlock-tamarack (north); [**Select Structural**] [**No. 1**] grade; NeLMA or NLGA.
3. Species and Grade: Hem-fir or hem-fir (north); [**Select Structural**] [**No. 1**] grade; NLGA, WCLIB, or WWPA.
4. Species and Grade: Mixed maple; [**Select Structural**] [**No. 1**] grade; NeLMA.
5. Species and Grade: Mixed oak; [**Select Structural**] [**No. 1**] grade; NeLMA.
6. Species and Grade: Southern pine; [**Select Structural**] [**No. 1**] grade; SPIB.
7. Maximum Moisture Content: [**20**] [**23**] <**Insert number**> percent.
8. Additional Restriction: Free of heart centers.

2.6 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.
7. Utility shelving.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species:

1. Hem-fir (north); NLGA.
2. Mixed southern pine or southern pine; SPIB.
3. Spruce-pine-fir; NLGA.
4. Hem-fir; WCLIB or WWPA.
5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
6. Western woods; WCLIB or WWPA.

7. Northern species; NLGA.
8. Eastern softwoods; NeLMA.

C. Utility Shelving: Lumber with 15 percent maximum moisture content of any of the following species and grades:

1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; Premium or No. 2 Common (Sterling) grade; NeLMA, NLGA, WCLIB, or WWPA.
2. Mixed southern pine or southern pine; No. 2 grade; SPIB.
3. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
4. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

D. Concealed Boards: 15 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
4. Eastern softwoods; No. 2 Common grade; NeLMA.
5. Northern species; No. 2 Common grade; NLGA.
6. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

E. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

F. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

G. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.7 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.8 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 or ICC-ES AC193 as appropriate for the substrate.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.9 METAL FRAMING ANCHORS

A. Allowable design loads, as published by manufacturer, shall meet or exceed those of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

1. Use for interior locations unless otherwise indicated.

C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.

1. Use for wood-preservative-treated lumber and where indicated.

D. Stainless-Steel Sheet: ASTM A 666, Type 304.

1. Use for exterior locations and where indicated.

2.10 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

B. Adhesives for Gluing to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

C. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.

E. Install shear wall panels to comply with manufacturer's written instructions.

F. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

G. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.

H. Do not splice structural members between supports unless otherwise indicated.

I. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

J. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

K. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function

of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

L. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

M. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

N. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).

O. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

P. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
1. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal-size furring horizontally at 24 inches o.c.

C. Furring to Receive Gypsum Board or Plaster Lath: Install 1-by-2-inch nominal-size furring vertically at 16 inches o.c.

3.4 WALL AND PARTITION FRAMING INSTALLATION

A. General: Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions. Fasten plates to supporting construction unless otherwise indicated.

1. Provide continuous horizontal blocking at midheight of partitions more than 96 inches high, using members of 2-inch nominal thickness and of same width as wall or partitions.

B. Construct corners and intersections with three or more studs.

C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.

1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal depth for openings 48 inches and less in width, 6-inch nominal depth for openings 48 to 72 inches in width, 8-inch nominal depth for openings 72 to 120 inches in width, and not less than 10-inch nominal depth for openings 10 to 12 feet in width.
2. For load-bearing walls, provide double-jamb studs for openings 60 inches and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated.

D. Provide diagonal bracing in exterior walls, at both walls of each external corner, at 45-degree angle, full-story height unless otherwise indicated. Use metal wall bracing, let into studs in saw kerf.

3.5 CEILING JOIST AND RAFTER FRAMING INSTALLATION

A. Ceiling Joists: Install with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.

1. Where ceiling joists are at right angles to rafters, provide additional short joists parallel to rafters from wall plate to first joist; nail to ends of rafters and to top plate, and nail to first joist or anchor with framing anchors or metal straps. Provide 1-by-8-inch nominal-size or 2-by-4-inch nominal-size stringers spaced 48 inches o.c. crosswise over main ceiling joists.

B. Rafters: Notch to fit exterior wall plates and use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.

1. At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against valley rafters.
2. At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against hip rafter.

C. Provide collar beams (ties) as indicated or, if not indicated, provide 1-by-6-inch nominal-size boards between every third pair of rafters, but not more than 48 inches o.c. Locate below ridge member, at third point of rafter span. Cut ends to fit roof slope and nail to rafters.

D. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

3.6 TIMBER FRAMING INSTALLATION

A. Install timber beams with crown edge up and provide not less than 4 inches of bearing on supports. Provide continuous members unless otherwise indicated; tie together over supports as indicated if not continuous.

B. Where beams or girders are framed into pockets of exterior concrete or masonry walls, provide 1/2-inch airspace at sides and ends of wood members.

C. Install wood posts using metal anchors indicated.

D. Treat ends of timber beams and posts exposed to weather by dipping in water-repellent preservative for 15 minutes.

3.7 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.
3. Parapet sheathing.
4. Composite nail base insulated roof sheathing.
5. Subflooring.
6. Underlayment.
7. Sheathing joint and penetration treatment.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for plywood backing panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated plywood.

2. Fire-retardant-treated plywood.
3. Foam-plastic sheathing.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 WOOD PANEL PRODUCTS

A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

B. Factory mark panels to indicate compliance with applicable standard.

2.3 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201/D 3201M at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high-temperature fire-retardant treatment is indicated, span ratings for temperatures up to 170 deg F shall be not less than span ratings specified.

C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

E. Application: Treat plywood indicated on Drawings, and the following:

1. Roof and wall sheathing within 48 inches of fire or party walls.
2. Subflooring and underlayment for raised platforms.

2.5 WALL SHEATHING

A. Plywood Sheathing: Exposure 1, Structural I sheathing.

1. Span Rating: Not less than 24/16.
2. Nominal Thickness: As indicated on the drawings..

B. Oriented-Strand-Board Sheathing: DOC PS 2, Exposure 1, Structural I sheathing.

1. Span Rating: Not less than 24/16.
2. Nominal Thickness: As indicated on the drawings..

C. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.

1. Type and Thickness: As indicated.

D. Cementitious Backer Units: ASTM C 1325, Type A.

1. Thickness: As indicated.

E. Extruded-Polystyrene-Foam Sheathing: ASTM C 578, Type IV, in manufacturer's standard lengths and widths with tongue-and-groove or shiplap long edges as standard with manufacturer.

1. Thickness: As indicated.
2. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

2.6 ROOF SHEATHING

A. Plywood Sheathing: Exposure 1, Structural I sheathing.

1. Span Rating: Not less than 32/16.
2. Nominal Thickness: As indicated on the drawings.

B. Oriented-Strand-Board Sheathing: DOC PS 2, Exposure 1, Structural I sheathing.

1. Span Rating: Not less than 32/16.
2. Nominal Thickness: As indicated on the drawings

2.7 COMPOSITE NAIL BASE INSULATED ROOF SHEATHING

A. Vented, Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing: ASTM C 1289, Type II, Class 1, with DOC PS 2, Exposure 1 oriented strand board adhered to spacers on one face.

1. Polyisocyanurate-Foam Thickness: 4 inches.
2. Oriented-Strand-Board Nominal Thickness: 7/16 inch.
3. Spacers: Wood furring strips or blocks not less than 3/4 inch thick and spaced not more than 12 inches o.c.

2.8 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof and sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Sheathing to Wood Framing: ASTM C 1002.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.

1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C 1002.
2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C 954.

G. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117. Provide washers or plates if recommended by sheathing manufacturer.

2.9 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Section 079200 "Joint Sealants."

B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

C. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Combination Subfloor-Underlayment:

    a. Glue and nail to wood framing.
    b. Screw to cold-formed metal framing.
    c. Space panels 1/8 inch apart at edges and ends.

2. Subflooring:

    a. Glue and nail to wood framing.
    b. Screw to cold-formed metal framing.
    c. Space panels 1/8 inch apart at edges and ends.

3. Wall and Roof Sheathing:

    a. Nail to wood framing.
    b. Screw to cold-formed metal framing.
    c. Space panels 1/8 inch apart at edges and ends.

4. Underlayment:

    a. Nail to subflooring.
    b. Space panels 1/32 inch apart at edges and ends.
    c. Fill and sand edge joints of underlayment receiving resilient flooring immediately before installing flooring.

3.3 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to wood framing with nails or screws.
2. Fasten gypsum sheathing to cold-formed metal framing with screws.
3. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
4. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.
2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.
2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

E. Seal sheathing joints according to sheathing manufacturer's written instructions using one of the options below as recommended by sheathing manufacturer.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

3.4 CEMENTITIOUS BACKER UNIT INSTALLATION

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.5 FOAM-PLASTIC SHEATHING INSTALLATION

A. Comply with manufacturer's written instructions.

B. Foam-Plastic Wall Sheathing: Install vapor-relief strips or equivalent for permitting escape of moisture vapor that otherwise would be trapped in stud cavity behind sheathing.

C. Apply sheathing tape to joints between foam-plastic sheathing panels and at items penetrating sheathing. Apply at upstanding flashing to overlap both flashing and sheathing.

3.6 PARTICLEBOARD UNDERLAYMENT INSTALLATION

A. Comply with CPA's recommendations for type of subfloor indicated. Fill and sand gouges, gaps, and chipped edges. Sand uneven joints flush.

1. Fastening Method: Glue and nail underlayment to subflooring.

3.7 HARDBOARD UNDERLAYMENT INSTALLATION

A. Comply with CPA's recommendations and hardboard manufacturer's written instructions for preparing and applying hardboard underlayment.

1. Fastening Method: Nail underlayment to subflooring.

END OF SECTION 061600

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Solid-surfacing-material countertops

B. Related Sections include the following:

1. Division 06 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
2. Division 09 Section "Gypsum Board Assemblies" for reinforcements in metal-framed partitions for anchoring manufactured wood casework.

1.3 DEFINITIONS

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

B. Exposed Portions of Cabinets: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches above floor, and surfaces visible in open cabinets.

C. Semiexposed Portions of Cabinets: Surfaces behind opaque doors, such as interiors of cabinets, shelves, dividers, interiors and sides of drawers, and interior faces of doors. Tops of cases 78 inches or more above floor are defined as semiexposed.

D. Concealed Portions of Cabinets: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, and ends and backs that are placed directly against walls or other cabinets.

E. Hardwood Plywood: A panel product composed of layers or plies of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or particleboard core, joined with adhesive, and faced both front and back with hardwood veneers.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated, including cabinet hardware and accessories.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for cabling installed in architectural woodwork.

C. Samples for Initial Selection:

1. Solid-surfacing material.

D. Product Certificates: For each type of product, signed by product manufacturer.

E. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

F. Qualification Data: For qualified Installer.

G. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.

B. Installer Qualifications: Fabricator of products or Certified participant in AWI's Quality Certification Program.

C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork.

D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. Provide AWI Quality Certification Program labels indicating that woodwork, including installation, complies with requirements of grades specified.

E. Mockups: Build mockup of wood wall panel system to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of manufactured wood casework that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Delamination of components or other failures of glue bond.
b. Warping of components.
c. Failure of operating hardware.
d. Deterioration of finishes.

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

1.10 EXTRA MATERIALS

A. Furnish complete touchup kit for each type and finish of manufactured wood casework provided. Include scratch fillers, stains, finishes, and other materials necessary to perform permanent repairs to damaged casework finish.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.

C. Wood Products: Comply with the following:

1. Hardboard: AHA A135.4, Class 1 Tempered
2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
3. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
4. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.
5. Softwood Plywood: DOC PS 1, Medium Density Overlay.
6. Hardwood Plywood: HPVA HP-1, either veneer core or particleboard core unless otherwise indicated.

D. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

1. Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semiexposed edges.

E. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.

1. Manufacturers: Subject to compliance with requirements, the following products are acceptable, but not limited to:

a. DuPont Corian.
b. Avonite, Inc.
c. Wilson Art.

2. Type: Standard type or Veneer type made from material complying with requirements for Standard type, as indicated, unless Special Purpose type is indicated.

2.2 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."

B. Butt Hinges: Chrome-plated, semiconcealed, 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide 2 hinges for doors less than 48 inches high and 3 hinges for doors more than 48 inches high.

C. Back-Mounted Pulls: BHMA A156.9, B02011.

D. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.

E. Catches: Magnetic catches, BHMA A156.9, B03141. Provide 2 catches on doors more than 48 inches high.

F. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

G. Shelf Rests: BHMA A156.9, B04013; metal, two-pin type with shelf hold-down clip.

H. Drawer Slides: BHMA A156.9, B05091.

1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
2. Box Drawer Slides: Grade 1; for drawers not more than 6 inches high and 24 inches wide.
3. File Drawer Slides: Grade 1HD-100; for drawers more than 6 inches high or 24 inches wide.
4. Pencil Drawer Slides: Grade 2; for drawers not more than 3 inches high and 24 inches wide.

I. Drawer and Hinged Door Locks: Cam type, brass with chrome-plated finish; complying with BHMA A156.11, Type E07281.

1. Provide a minimum of two keys per lock and two master keys.
2. Provide on all base cabinet and wall cabinet doors.
3. Master Key System: Key all locks to be operable by master key.

J. Grommets for Cable Passage through Countertops: 1-1/4-inch or 2-inch OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.

K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.

L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.3 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: softwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

C. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

D. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Contact Adhesive: 250 g/L.

E. Adhesive for Bonding Plastic Laminate: Manufacturer's standard waterproof, urea-formaldehyde-free adhesive.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.4 FABRICATION, GENERAL

A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Fabricate woodwork to dimensions, profiles, and details indicated.

D. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.

2.5 SOLID-SURFACING-MATERIAL COUNTERTOPS

A. Grade: Custom.

B. Solid-Surfacing-Material Thickness: 3/4 inch.

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:

1. As selected by Architect from manufacturer's full range of standard colors and textures. Refer to the materials legend within the drawing set.

D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

1. Fabricate tops with shop-applied edges of materials and configuration indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.

C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Maintain veneer sequence matching of cabinets with transparent finish.
3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips, No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish, or toggle bolts through metal backing or metal framing behind wall finish.

G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
3. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
4. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."

H. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semiexposed surfaces. Repair shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board.
2. Molded polystyrene foam-plastic board.
3. Glass-fiber blanket.
4. Mineral-wool blanket.
5. Loose-fill insulation.

B. Related Requirements:

1. Section 061600 "Sheathing" for foam-plastic board sheathing installed directly over wood or steel framing.
2. Section 075423 "Thermoplastic Polyolefin (TPO) Roofing" for insulation specified as part of roofing construction.
3. Section 092900 "Gypsum Board Assemblies" for sound attenuation blanket used as acoustic insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Low-emitting product certification.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.

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. DiversiFoam Products.
b. Dow Chemical Company (The).
c. Owens Corning.

2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

B. Extruded Polystyrene Board, Type IV: Slab perimeter insulation ASTM C 578, Type IV, 25-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

C. Extruded Polystyrene Board, Type IV, Drainage Panels: ASTM C 578, Type IV, 25-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

D. Extruded Polystyrene Board, Type V Deck insulation: ASTM C 578, Type V, 100-psi minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

2.2 GLASS-FIBER BLANKET

A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

B. Glass-Fiber Blanket, Kraft Faced ASTM C 665, Type II (nonreflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier).

C. Glass-Fiber Blanket, Reinforced-Foil Faced: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

2.3 MINERAL-WOOL BLANKETS

A. Mineral-Wool Blanket, Unfaced: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.4 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

C. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.

3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
6. For wood-framed construction, install blankets according to ASTM C 1320 and as follows:

    a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

7. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.

    a. Exterior Walls: Set units with facing placed toward as indicated on Drawings.
    b. Interior Walls: Set units with facing placed as indicated on Drawings.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.5 INSTALLATION OF REFLECTIVE INSULATION

A. Install sheet reflective insulation according to ASTM C 727.

B. Install sheet radiant barriers according to ASTM C 1744.

C. Install interior radiation control coating system according to ASTM C 1321.

3.6 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 075423 - THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:
   1. Fully adhered thermoplastic polyolefin (TPO) sheet membrane roofing over mechanically attached insulation and cover board.
   2. Mechanical hoisting equipment, operating personnel and required rigging to perform the work of this section.

B. Related Work:
   1. Division 5 Section “Steel Decking”: Steel roof deck.
   2. Division 6 Section “Rough Carpentry”: Wood blocking and nailers.
   3. Division 7 Section “Sheet Metal Flashing and Trim”.
   4. Division 7 Section “Roof Accessories”.
   5. Division 7 Section “Joint Sealants”.

1.2 PERFORMANCE REQUIREMENTS

A. Install sheet membrane roofing and base flashing that are watertight; will not permit the passage of liquid water; and will withstand wind loads, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.

C. 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, and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.

   1. Fire/Windstorm Classification: Class 1A-90.
   2. Hail Resistance: MH.

D. Energy Performance: Provide roofing system with initial Solar Reflectance Index not less than 78 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.

1.3 SUBMITTALS

A. Submit in accordance with Division 1 Section “Submittal Procedures”, product data, installation instructions, and general recommendations from manufacturer of single-ply membrane system for types of roofing required. Include data substantiating that materials comply with requirements.

B. Submit shop drawings:
   1. Shop drawings shall indicate fabricated flashings, flashings for pipe vents, roof drains, fascia/gravel stops, and other work, thickness of metals, dimensions, fastening methods, expansion joints and other provisions necessary for thermal expansion and contraction.
   2. Shop drawings for sheet membrane roofing shall include the following:
      a. Outline of the roof and roof size.
      b. Location and type of penetrations.
      c. Perimeter and penetration details.
      d. Special details.
      e. Bill of Materials.
   3. Indicate layout of tapered insulation materials.

C. Samples: Submit samples of finished roofing sheets, including T-shaped side/end-lap seam. Also include the following:
   1. Insulation board.
   2. Cover board.
   3. Vapor barrier.

D. Submit pre-roofing conference records.

E. Submit test data for pullout resistance of fastening systems.

F. Submit a certificate, signed by the roofing membrane manufacturer and by the roofing subcontractor, stating that the roofing, flashing and roof insulation proposed to be used comply with these specifications, and that the installation complies with the manufacturer's printed instructions and are proper and adequate for the proposed installation and use.
   1. Certificate shall state that a warranty shall be issued as specified, upon completion of the roofing installation.

G. Submit a copy of the warranty to be issued, for review.

H. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.4 QUALITY ASSURANCE

A. Manufacturer: Obtain primary single-ply membrane roofing from a single manufacturer. Provide secondary materials as recommended by manufacturer of primary materials.

B. Installer: Engage an experienced Installer that has specialized in installing roofing systems similar to those required for this Project. Installer must be acceptable to or licensed by manufacturer of primary roofing material.
   1. Work associated with single-ply membrane roofing, including (but not limited to) insulation, flashing, and membrane sheet joint sealers, is to be performed by Installer of this Work.

C. Preinstallation Conference: Before installing roofing system, conduct conference at Project site to comply with requirements of Division 1 Section “Project Meetings”. Notify participants at least 5 working days before conference.
   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 installation, including manufacturer's written instructions.
3. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
4. Review loading limitations of deck during and after roofing.
5. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing.
6. Review governing regulations and requirements for insurance, certificates, and inspection and testing, if applicable.
7. Review temporary protection requirements for roofing system during and after installation.
8. Review roof observation and repair procedures after roofing installation.
9. Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.

D. UL Listing: Provide labeled materials that have been tested and listed by UL in "Building Materials Directory" or by other nationally recognized testing laboratory for Class A rated materials/system.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site in the manufacturer's original labeled containers, packages and rolls.

B. Store roofing materials and insulation on raised platforms and protect from moisture. Provide fire preventive measures for storage areas.
1. Store adhesives at temperatures above 40 degrees F.
2. Limit storage loading on roof decks during installation period to 30 pounds per square foot of uniformly distributed load.

C. Provide other protection as required by the roofing materials manufacturer.
1. Replace materials damaged during handling or storage.
2. Remove damaged materials from the premises immediately.

1.6 PROJECT CONDITIONS

A. Weather: Proceed with roofing work when existing and forecasted weather conditions permit work to be performed in accordance with manufacturers' recommendations and warranty requirements.

B. Substrate Conditions: Do not begin roofing installation until substrates have been inspected and are determined to be in satisfactory condition.

1.7 WARRANTY

A. Roofing Subcontractor's Warranty: The roofing subcontractor shall submit to the Owner a two-year workmanship warranty signed and countersigned by Installer (Roofer) and Contractor. In

the event that any roofing work including roofing membrane, composition flashing, roof insulation, and roof accessories, is found to be defective or otherwise not in accordance with the Contract Documents within two years of substantial completion, the roofing subcontractor shall remove and replace such defective work at no additional cost to the Owner. The roofing subcontractor's warranty obligation shall be directly to the Owner, and a copy shall be sent to the roofing membrane manufacturer.

B. Manufacturer's Warranty: Submit executed copy of membrane manufacturer's "Total Roofing System Warranty" agreement covering materials and workmanship for the entire roofing system including all materials supplied or specifically approved by the membrane manufacturer. Provide warranty signed by an authorized representative of roofing membrane manufacturer. Provide form that was published with product literature as of date of Contract Documents.
   1. Warranty period shall be 20 years subsequent to the date of Substantial Completion of the Project.

C. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

D. Signed warranties as specified, must be submitted to the Architect before final payment for the membrane roofing work will be made.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide membrane roofing system from one of the following manufacturers (no substitutions):
   1. Carlisle Syntec Systems.
   2. GenFlex Roofing Systems, GenCorp Polymer Products.
   3. Versico Inc.

2.2 ROOF MEMBRANE

A. Fabric-Reinforced Thermoplastic Polyolefin Sheet: Uniform, flexible sheet formed from a thermoplastic polyolefin, polypropylene resin, internally fabric or scrim reinforced, and as follows:
   1. Breaking Strength: 225 lbf (1 kN); ASTM D 751, grab method.
   2. Elongation at Break: 15 percent; ASTM D 751.
   3. Tearing Strength: 55 lbf (245 N) minimum; ASTM D 751, Procedure B.
   4. Brittleness Point: Minus 22 deg F (30 deg C).
   5. Ozone Resistance: No cracks after sample, wrapped around a 3-inch- (75-mm-) diameter mandrel, is exposed for 166 hours to a temperature of 104 deg F (40 deg C) and an ozone level of 100 pphm (100 mPa); ASTM D 1149.
   6. Resistance to Heat Aging: 90 percent minimum retention of breaking strength, elongation at break, and tearing strength after 166 hours at 240 deg F (116 deg C); ASTM D 573.
   7. Water Absorption: Less than 4 percent mass change after 166 hours' immersion at 158 deg F (70 deg C); ASTM D 471.

8. Linear Dimension Change: Plus or minus 2 percent; ASTM D 1204.
9. Thickness: 60 mils, nominal.
10. Exposed Face Color: Tan.

2.3 AUXILIARY MATERIALS

A. Reinforced-Polyethylene Vapor Retarder: 2 outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nylon cord or polyester scrim and weighing not less than 25 lb/1000 sq. ft., with maximum permeance rating of 0.0403 perm.
   1. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indices of 25 and 50, respectively.

B. Thermal Barrier: Gypsum board, ASTM C36, Type X, 5/8 inch thick.

C. Cover Board: Glass-mat, water-resistant gypsum board, ASTM C1177, of type and thickness indicated below:
   1. Type and Thickness: Regular, 1/2 inch (12.7 mm).
   2. Product: Subject to compliance with requirements, provide "Dens-Deck" manufactured by Georgia-Pacific Corp.

D. Cant Strips, Tapered Edge Strips, and Flashing Accessories: Types recommended by membrane manufacturer, including adhesive tapes, flashing cements, and sealants.

E. Flashing Material: Manufacturer's standard system compatible with single-ply membrane.

F. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions of FM 4470, designed for fastening sheet to substrate, and acceptable to roofing system manufacturer.

G. Membrane Adhesive: As recommended by membrane manufacturer for particular substrate and project conditions, formulated to withstand minimum 90-psf uplift force.

2.4 INSULATING MATERIALS

A. Extruded-Polystyrene Board Insulation: Rigid, cellular, thermal insulation with closed cells and integral high-density skin, complying with ASTM C578 for Type indicated; with 5-year aged r-values of 5.4 and 5.0 at 40 degrees and 75 degrees F (4.4 degrees and 23.9 degrees C), respectively, and as follows:
   1. Type IV, 1.6-pcf minimum density.
      a. Surface Burning Characteristics: Maximum flame-spread and smoke-developed values of 5 and 165, respectively.
   2. Provide tapered boards where indicated for sloping to drain. Fabricate with taper of 1/4 inch per foot.
   3. Manufacturers:
      a. DiversiFoam Products.
      b. Dow Chemical Company.
      c. Owens Corning.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions of FM 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

2.5 WALKWAYS

A. Walkway Pads: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway pads, approximately 3/16 inch (5 mm) thick, and acceptable to roofing system manufacturer.

B. Walkway Rolls: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway rolls, approximately 3/16 inch (5 mm) thick, and acceptable to roofing system manufacturer.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

A. Comply with manufacturers' instructions to prepare substrate to receive single-ply membrane system.
   1. Verify that penetrations, expansion joints, and blocking are in place and secured and that roof drains are properly clamped into position.
   2. Examine roof deck surfaces for defects that will adversely affect roofing installation such as excessive surface roughness, contaminated surfaces, and structurally unsound substrates.

B. Clean substrate of dust, debris, and other substances detrimental to roofing system work. Remove sharp projections.

C. Install cant strips, flashings, and accessory items as shown and as recommended by manufacturer.

D. Prevent compounds from entering and clogging drains and conductors and from spilling or migrating onto surfaces of other work.

3.2 INSTALLATION

A. Start installation only in presence of manufacturer's technical representative.

B. Comply with UL requirements for fire rated roof constructions and comply with FM requirements for "Class 1" metal deck construction and 1-90 roof construction.
   1. For membrane roofing on concrete roof decks, comply with UL Design No. D907 and additional requirements indicated.
   2. For membrane roofing on steel roof decks, comply with UL Design No. P717 and additional requirements indicated.

C. Install vapor retarder over all roof decks, in accordance with the manufacturer's recommended application method. Install vapor retarder over a clean and dry deck. Lap all edges 2 inches

and seal with adhesive or tape. Install no more vapor retarder in one day than can be properly covered and capped that day.

D. Over steel decks, install thermal barrier perpendicular to steel roof deck with end joints staggered a minimum of 1 foot and occurring over crests of steel roof deck.

3.3 INSTALLING INSULATION

A. Extend insulation full thickness in two layers, or in multiple layers over entire surface to be insulated, cutting and fitting tightly around obstructions. Form crickets, saddles, and tapered areas with additional material as shown and as required for proper drainage of membrane.
   1. Stagger joints in one direction for each course. For multiple layers, stagger joints in both directions between courses with no gaps to form a complete thermal envelope.
   2. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
   3. Install sprayfoam insulation between insulation and nailers or other elements to fill the joint. Sprayfoam insulation to be of the type that is compatible with the insulation and the roof membrane.
   4. Where there are multiple new layers, fasten first layer mechanically, and set each subsequent layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
   5. Provide tapered units to suit drainage pattern indicated.
   6. Install cover board in single layer over insulation.

B. Do not install more insulation each day than can be covered with membrane before end of day and before start of inclement weather.

C. Install insulation to required thickness in 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

D. Secure cover board and roof insulation to roof deck with mechanical anchors of type and spacing indicated; but in no case provide less than one anchor per 4 square feet of surface area or less anchorage than required by FM "Loss Prevention Data Sheet 1-28."

3.4 INSTALLING MEMBRANE

A. Start installation only in presence of manufacturer's technical representative.
   1. Cut out and repair membrane defects at the end of each day's work.

B. Fully Adhered Membrane: Install membrane by unrolling over prepared substrate, lapping adjoining sheets as recommended by manufacturer. Apply adhesive to surfaces to be bonded and roll into place when adhesive has properly cured. Heat weld seams and apply sealant to exposed sheet edges, tapering application as recommended by manufacturer. Install mechanical fasteners, flashings and counterflashings, and accessories at locations and as recommended by manufacturer.

3.5 WALKWAY INSTALLATION

A. Walkways: Install walkway products in locations indicated. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.6 FIELD QUALITY CONTROL

A. Verify field strength of seams a minimum of twice daily, according to manufacturer's written instructions, and repair seam sample areas.

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
1. Notify Architect or Owner 48 hours in advance of the date and time of inspection.

3.7 PROTECTING ROOFING

A. After completing roofing (including associated work), institute appropriate procedures for surveillance and protection of roofing during remainder of construction period. At the end of the construction period, or at a time when remaining construction will in no way affect or endanger roofing, make a final inspection of roofing and prepare a written report to Owner, describing nature and extent of deterioration or damage found.

B. Repair or replace deteriorated or defective work found at the time of final inspection to a condition free of damage and deterioration at the time of Substantial Completion and according to the requirements of the specified warranty.

END OF SECTION 075423

SECTION 076200 - SHEET METAL FLASHING AND TRIM

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. Manufactured through-wall flashing with snaplock receiver.
2. Manufactured reglets with counterflashing.
3. Formed roof-drainage sheet metal fabrications.
4. Formed low-slope roof sheet metal fabrications.
5. Formed steep-slope roof sheet metal fabrications.
6. Formed wall sheet metal fabrications.
7. Formed equipment support flashing.
8. Formed overhead-piping safety pans.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
10. Include details of special conditions.
11. Include details of connections to adjoining work.
12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

D. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.
4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1. For copings and roof edge flashings that are FM Approvals approved, shop shall be listed as able to fabricate required details as tested and approved.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockup of typical roof eave, including gutter, fascia, fascia trim & apron flashing, approximately 10 feet long, including supporting construction cleats, seams, attachments, underlayment, and accessories.
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.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.10 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

D. FM Approvals Listing: Manufacture and install copings and roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with name of fabricator and design approved by FM Approvals.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 or H01 temper.

1. Nonpatinated Exposed Finish: Mill.

C. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.

1. As-Milled Finish: Mill (in areas not exposed to view).

2. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
b. Color: As selected by Architect from manufacturer's full range.

3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

D. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666,, dead soft, fully annealed; with smooth, flat surface.

1. Finish: 2D (dull, cold rolled).

2.3 UNDERLAYMENT MATERIALS

A. Felt: ASTM D 226**/**D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.

B. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F; and complying with physical requirements of ASTM D 226/D 226M for Type I and Type II felts.

C. Self-Adhering, High-Temperature Sheet: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.

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. Carlisle Residential; a division of Carlisle Construction Materials.
b. Grace Construction Products; W.R. Grace & Co. -- Conn.
c. Protecto Wrap Company.
d. SDP Advanced Polymer Products Inc.

2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.

D. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft.minimum.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Copper Sheet: Copper, hardware bronze or passivated Series 300 stainless steel.
3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.

C. Solder:

1. For Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.
2. For Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

E. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.

H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

A. Through-Wall, Ribbed, Sheet Metal Flashing: Manufacture through-wall sheet metal flashing for embedment in masonry, with ribs at 3-inch intervals along length of flashing to provide integral mortar bond. Manufacture through-wall flashing with snaplock receiver on exterior face to receive counterflashing.

1. Stainless Steel: 0.016 inch thick.

B. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with interlocking counterflashing on exterior face, of same metal as reglet.

1. Material: Stainless steel, 0.019 inch thick.
2. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.

3. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
4. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
5. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
6. Accessories:

    a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
    b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.

7. Finish: Mill.

2.6 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

G. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

H. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

I. Do not use graphite pencils to mark metal surfaces.

2.7 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch-long sections. Furnish gutter brackets and gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.

1. Gutter Profile: Match existing gutters.
2. Expansion Joints: Match existing gutters.
3. Accessories: Continuous, removable leaf screen with sheet metal frame and hardware cloth screen & Valley baffles.
4. Gutters with Girth up to 15 Inches: Fabricate from the following materials:

    a. Copper: 16 oz./sq. ft..
    b. Aluminum: 0.032 inch thick.
    c. Stainless Steel: 0.016 inch thick.

B. Downspouts: Fabricate round downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.

1. Fabricated Hanger Style: Match existing

C. Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch-wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fabricate from the following materials:

1. Copper: 16 oz./sq. ft..Where exposed to view
2. Stainless Steel: 0.019 inch thick in concealed locations

D. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:

1. Copper: 16 oz./sq. ft..

E. Splash Pans: Fabricate to dimensions and shape required and from either of the following materials:

1. Aluminum: 0.040 inch thick.
2. Stainless Steel: 0.019 inch thick.

2.8 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Copings: Fabricate in minimum 96-inch-long, but not exceeding 12-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, solder or weld watertight. Shop fabricate interior and exterior corners.

1. Coping Profile: as indicated on the drawings, and according to SMACNA's "Architectural Sheet Metal Manual."
2. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
3. Fabricate from the Following Materials:

    a. Copper: 24 oz./sq. ft..

B. Roof-to-Wall Transition Expansion-Joint Cover: Fabricate from the following materials: Shop fabricate interior and exterior corners.

1. Copper: 16 oz./sq. ft. where exposed to view.
2. Stainless Steel: 0.025 inch thick.

C. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Copper: 20 oz./sq. ft. where exposed to view
2. Stainless Steel: 0.019 inch thick.

D. Counterflashing: Fabricate from the following materials:

1. Copper: 16 oz./sq. ft. where exposed to view
2. Stainless Steel: 0.019 inch thick.

E. Flashing Receivers: Fabricate from the following materials:

1. Copper: 16 oz./sq. ft. where exposed to view
2. Stainless Steel: 0.016 inch thick.

F. Roof-Penetration Flashing: Fabricate from the following materials:

1. Copper: 16 oz./sq. ft.where exposed to view.
2. Stainless Steel: 0.019 inch thick.

2.9 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:

1. Copper: 16 oz./sq. ft..

B. Valley Flashing: Fabricate from the following materials:

1. Copper: 16 oz./sq. ft..

C. Drip Edges: Fabricate from the following materials:

1. Copper: 16 oz./sq. ft..

D. Eave, Rake, Ridge, and Hip Flashing: Fabricate from the following materials:

1. Copper: 16 oz./sq. ft..

E. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Copper: 16 oz./sq. ft..

F. Flashing Receivers: Fabricate from the following materials:

1. Copper: 16 oz./sq. ft..

G. Roof-Penetration Flashing: Fabricate from the following materials:

1. Copper: 16 oz./sq. ft..

2.10 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot-long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch-high, end dams. Fabricate from the following materials:

1. Stainless Steel: 0.016 inch thick.

B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high, end dams. Fabricate from the following materials:

1. Stainless Steel: 0.016 inch thick.

2.11 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:

1. Copper: 16 oz./sq. ft. where exposed to view
2. Stainless Steel: 0.019 inch thick in areas screened from view.

B. Overhead-Piping Safety Pans: Fabricate from the following materials:
1. Stainless Steel: 0.025 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

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

3.2 UNDERLAYMENT INSTALLATION

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.

C. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.

D. Apply slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.

4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.
6. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use soldered joints in copper and stainless steel unless otherwise indicated

2. For sealant joints, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
3. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work.

1. Do not solder aluminum sheet.
2. Do not use torches for soldering.
3. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
4. Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering.

Comply with solder manufacturer's recommended methods for cleaning and neutralization.

5. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.

H. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.4 ROOF-DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters: Join sections with riveted and soldered joints. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and solder watertight. Slope to downspouts.

1. Fasten gutter spacers to front and back of gutter.
2. Anchor and loosely lock back edge of gutter to continuous cleat.
3. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches apart.
4. Anchor gutter with gutter brackets spaced not more than 36 inches apart to roof deck, unless otherwise indicated, and loosely lock to front gutter bead.
5. Anchor gutter with spikes and ferrules spaced not more than 30 inches apart.
6. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.
7. Install continuous gutter screens on gutters with noncorrosive fasteners, removable for cleaning gutters.
8. Anchor and loosely lock back edge of gutter to continuous cleat.
9. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 18 inches apart.
10. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.

C. Downspouts: Join sections with 1-1/2-inch telescoping joints.

1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c.
2. Provide elbows at base of downspout to direct water away from building.
3. Connect downspouts to underground drainage system.

D. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in adhesive compatible with the substrate.

E. Parapet Scuppers: Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

1. Anchor scupper closure trim flange to exterior wall and solder to scupper.
2. Loosely lock front edge of scupper with conductor head.
3. Solder exterior wall scupper flanges into back of conductor head.

F. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of 1 inch below scupper or gutter discharge.

G. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints minimum of 4 inches in direction of water flow.

3.5 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches 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 minimum of 4 inches. Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant unless otherwise indicated.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.6 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Through-Wall Flashing: Installation of through-wall flashing is specified in Section 044313 "Anchored Stone Masonry Veneer."

C. Reglets: Installation of reglets is specified in Section 033000 "Cast-in-Place Concrete."

D. Opening Flashings in Frame Construction: Install continuous head, sill, and similar flashings to extend 4 inches beyond wall openings.

3.7 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

B. Overhead-Piping Safety Pans: Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

3.8 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.9 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 078123 - INTUMESCENT FIREPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes mastic and intumescent fire-resistive coatings (paint).

B. Related Requirements:

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at project site.

1. Review products, design ratings, restrained and unrestrained conditions, thicknesses, and other performance requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Framing plans or schedules, or both, indicating the following:

1. Extent of fireproofing for each construction and fire-resistance rating.
2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
4. Treatment of fireproofing after application.

C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard dimensions in size.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer and testing agency.

B. Product Certificates: For each type of fireproofing.

C. Evaluation Reports: For fireproofing, from ICC-ES.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of each type of fireproofing and different substrate with each required finish as shown on Drawings.
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.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 50 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.

B. Source Limitations: Obtain fireproofing for each fire-resistance design from single source.

C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263 testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

D. Asbestos: Provide products containing no detectable asbestos.

2.2 MASTIC AND INTUMESCENT FIRE-RESISTIVE COATINGS

A. Mastic and Intumescent Fire-Resistive Coating UL: X620. Manufacturer's standard, factory-mixed formulation and complying with indicated fire-resistance design. Products that may be incorporated into the work, but are not limited to:

1. Carboline Company
2. Hilti, Inc.
3. Isolatek International

B. Product Data:

1. Application: Designated for "exterior", "interior general purpose", and "conditioned interior space purpose" use by a qualified testing agency acceptable to authorities having jurisdiction.
2. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design.
3. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    a. Flame-Spread Index: 25 or less.
    b. Smoke-Developed Index: 50 or less.
4. Hardness: Not less than 80, Type D durometer, according to ASTM D 2240.
5. Finish: As selected by Architect from manufacturer's standard finishes.
    a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

C. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by fireproofing manufacturer.

D. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by fireproofing manufacturer. Include pins and attachment.

E. Topcoat: Suitable for application over applied fireproofing; of type recommended in writing by fireproofing manufacturer for each fire-resistance design.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design.

1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
2. Verify that objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
3. Verify that substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.

B. Conduct tests according to fireproofing manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.

C. 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. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.

B. Clean substrates of substances that could impair bond of fireproofing.

C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.

D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, topcoats, finishing, and other materials and procedures affecting fireproofing work.

B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable

to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.

1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.

D. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.

E. Spray apply fireproofing to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.

F. Extend fireproofing in full thickness over entire area of each substrate to be protected.

G. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.

H. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.

I. Cure fireproofing according to fireproofing manufacturer's written instructions.

J. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.

K. Finishes: Where indicated, apply fireproofing to produce the following finishes:

1. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.
2. Spray-Textured Finish: Finish left as spray applied with no further treatment.
3. Rolled, Spray-Textured Finish: Even finish produced by rolling spray-applied finish with a damp paint roller to remove drippings and excessive roughness.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Test and inspect as required by the IBC, Subsection 1705.14, "Mastic and Intumescent Fire-Resistant Coatings."

B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed

applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.

C. Fireproofing will be considered defective if it does not pass tests and inspections.

1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

D. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing is without damage or deterioration at time of Substantial Completion.

C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.

D. Repair fireproofing damaged by other work before concealing it with other construction.

E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 078123

SECTION 078413 - PENETRATION FIRESTOPPING

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 penetration firestopping systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

B. Related Sections include the following:

1. Division 22 and 23 Sections specifying duct and piping penetrations.
2. Division 26, 27, and 28 Sections specifying cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

1. Fire-resistance-rated walls including fire partitions and fire barriers.
2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies and ceiling membranes of roof/ceiling assemblies.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:

    a. Penetrations located outside wall cavities.
    b. Penetrations located outside fire-resistance-rated shaft enclosures.

C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance.

B. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, OPL, ITS, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems complying with the following requirements:

    a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
    b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:

        1) UL in its "Fire Resistance Directory."
        2) OPL in its "Directory of Listed Building Products, Materials, & Assemblies."
        3) ITS in its "Directory of Listed Products."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and

manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, through-penetration firestop systems that may be incorporated into the Work include, but are not limited to, those systems required to maintain the ratings of the walls, roofs and floors shown on the drawings that are available from the following manufacturers:

1. Grace, W. R. & Co. - Conn.
2. Hilti, Inc.
3. Johns Manville.
4. Nelson Firestop Products.
5. 3M; Fire Protection Products Division.
6. Tremco; Sealant/Weatherproofing Division.
7. USG Corporation.

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:

    a. Slag-/rock-wool-fiber insulation.
    b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
    c. Fire-rated form board.
    d. Fillers for sealants.

2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.3 FILL MATERIALS

A. General: Provide through-penetration firestop systems containing the types of fill materials required to maintain the ratings of the walls, roofs and floors shown on the drawings. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.

B. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.

E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

2.4 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.

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

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify through-penetration firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:

1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Through-penetration firestop system designation of applicable testing and inspecting agency.
4. Date of installation.
5. Through-penetration firestop system manufacturer's name.
6. Installer's name.

3.5 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 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 horizontal nontraffic surfaces:

    a. Perimeter joints between exterior wall surfaces and frames of exterior doors, and windows.
    b. Other joints as indicated.

2. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:

    a. Perimeter joints between interior wall surfaces and frames of interior doors, and windows.
    b. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    c. Joints between finished dissimilar materials, including, but not limited to, between counters and walls, drywall and masonry, drywall and metal panels, masonry and metal panels.
    d. Other joints as indicated.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for concrete wall control and expansion joint fillers and gaskets.
2. Division 04 Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
3. Division 07 Section "Firestopping" for fire-resistant building joint-sealant systems.
4. Division 08 Section "Glazing" for glazing sealants.
5. Division 09 Section "Gypsum Board Assemblies" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.

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.

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

1.4 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

D. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.

E. Qualification Data: For Installer and testing agency.

F. Warranties: Special warranties specified in this Section.

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 ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Submit not fewer than eight 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 use of specially formulated primers.

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 or are below 40 deg F.
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. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

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

C. Special Manufacturer's Warranty: Written warranty, signed by elastomeric sealant manufacturer agreeing to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

D. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:

1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range for this characteristic.

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant in the Elastomeric Joint-Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.

B. Additional Movement Capability: Where additional movement capability is specified in the Elastomeric Joint-Sealant Schedule, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at the time of installation and remain in compliance with other requirements of ASTM C 920 for uses indicated.

C. Stain-Test-Response Characteristics: Where elastomeric sealants are specified in the Elastomeric Joint-Sealant Schedule to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

D. Exterior/Interior pavements: Multicomponent, Pourable, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type M, Grade P, Class 100/50, for Use T.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; FC Parking Structure Sealant.
b. May National Associates, Inc.; Bondaflex Sil 728 RCS.

E. Exterior concrete and masonry: Multicomponent, Nonsag, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 50, for Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Pecora Corporation; Dynatrol II.
b. Polymeric Systems, Inc.; PSI-270.
c. Tremco Incorporated; Dymeric 240.

F. Single-Component Neutral- and Basic-Curing Silicone Sealant:

1. Available Products:
a. GE Silicones; SilPruf SCS2000.

b. Pecora Corporation; 890.
c. Tremco; Spectrem 3.

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 50.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
   a. Use O Joint Substrates: color anodic aluminum, galvanized steel, brick, ceramic tile and wood.
6. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.

G. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant:

1. Available Products:
   a. Pecora Corporation; 898.
   b. Tremco; Tremsil 200.
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: tile and plumbing fixtures
6. Location(s):
   a. Restrooms

H. LATEX JOINT SEALANTS

1. Latex Sealant: Comply with ASTM C 834, Type P, Grade NF.
2. Products:
   a. Bostik Findley; Chem-Calk 600.
   b. Pecora Corporation; AC-20+.
   c. Schnee-Morehead, Inc.; SM 8200.
   d. Sonneborn, Division of ChemRex Inc.; Sonolac.
   e. Tremco; Tremflex 834.

I. ACOUSTICAL JOINT SEALANTS

1. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following:
   a. 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. Available Products:
   a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
   b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

2.4 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:

1. Type C: Closed-cell material with a surface skin.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.5 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:

a. Concrete.
b. Masonry.

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.

a. Metal.
b. Glass.

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 in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. 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.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. 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 sealant from surfaces adjacent to joints.

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 where indicated per Figure 5B in ASTM C 1193.

5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 5C in ASTM C 1193.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

G. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer's written instructions.

3.4 CLEANING

A. Clean off excess sealant 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 original Work.

END OF SECTION 079200

SECTION 081113 - 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Standard hollow metal doors and frames.

B. Related Sections:

1. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
2. Division 08 Section "Door Hardware" for door hardware for hollow metal doors.
3. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.
4. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators.

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, fire-resistance rating, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door 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.

9. Details of conduit and preparations for power, signal, and control systems.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

B. Comply with ANSI A 250.8, unless more stringent requirements are indicated.

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 frames 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. Ceco Door Products; an Assa Abloy Group company.
2. Curries Company; an Assa Abloy Group company.
3. Steelcraft; an Ingersoll-Rand company.
4. Windsor Republic Doors.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.

C. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

E. 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.

F. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

G. 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.

H. Glazing: Comply with requirements in Division 08 Section "Glazing."

I. 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.

a. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 4.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.

1) Locations: Exterior doors.

3. Vertical Edges for Single-Acting Doors: Manufacturer's standard.
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 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 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless).

C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated. 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 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless).

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

E. 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 and frames in high humidity areas (pool, equipment, shower/restroom): Fabricated from metallic-coated steel sheet.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames as full profile welded unless otherwise indicated.
3. Frames for Level 2 Steel Doors: 0.053-inch- thick steel sheet.

C. Interior Frames: Fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames as full profile welded unless otherwise indicated.
3. Frames for Level 2 Steel Doors: 0.053-inch- thick steel sheet.
4. Frames for Wood Doors: 0.053-inch- thick steel sheet.
5. Frames for Borrowed Lights: Same as adjacent door frame.

D. 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. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
3. Postinstalled 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.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick

2.6 HOLLOW METAL PANELS

A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

2.7 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.

B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

1. Provide nonremovable stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.

2. Provide screw-applied, removable, glazing stops on inside of glass, louvers, and other panels in doors.

2.8 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.

2.9 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.
2. Glazed Lites: Factory cut openings in doors.

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. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed 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. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Two anchors per jamb up to 60 inches high.
        2) Three anchors per jamb from 60 to 90 inches high.
        3) Four anchors per jamb from 90 to 120 inches high.
        4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

    b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Three anchors per jamb up to 60 inches high.
        2) Four anchors per jamb from 60 to 90 inches high.
        3) Five anchors per jamb from 90 to 96 inches high.
        4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
        5) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.

c. 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.
b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet. Reinforce all frames for closers even when door is not scheduled to receive a closer.

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 08 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.

G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow metal work.
5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.10 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. At fire-protection-rated openings, install frames according to NFPA 80.

b. 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.
c. Install frames with removable glazing stops located on secure side of opening.
d. Install door silencers in frames before grouting.
e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

   a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. 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.
6. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
8. 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. Non-Fire-Rated Standard Steel Doors:

   a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
   b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
   c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.

d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

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.

END OF SECTION 081113

SECTION 083113 - ACCESS 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 01 Specification Sections, apply to this Section..

1.2 SUMMARY

A. This Section includes the following:

1. Access doors and frames for walls and ceilings.

B. Related Sections include the following:

1. Division 04 Section "Unit Masonry Assemblies" for anchoring and grouting access door frames set in masonry construction.
2. Division 09 Section "Gypsum Board Assemblies" for mounting of doors and frames in gypsum board walls or ceilings.

1.3 SUBMITTALS

A. Product Data: For each type of access door and frame indicated. Include construction details, materials, individual components and profiles, and finishes.

B. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

C. Ceiling Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim are shown and coordinated with each other.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain access door(s) and frame(s) through one source from a single manufacturer.

1.5 COORDINATION

A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.1 STEEL MATERIALS

A. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS) with A60 zinc-iron-alloy (galvannealed) coating or G60 mill-phosphatized zinc coating; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified thickness according to ASTM A 924/A 924M.

B. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation for Metallic-Coated Steel Sheet: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

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

2. Factory-Primed Finish: Apply shop primer immediately after cleaning and pretreating.
3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

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.

D. Plaster Beads: Casing bead formed from 0.0299-inch zinc-coated steel sheet with flange formed out of expanded metal lath and in size to suit thickness of plaster.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Medium-Security, Flush Access Doors with Trimless Frames: Fabricated from galvanized steel sheet.

1. Locations: Wall and ceiling surfaces.
2. Door: Minimum 0.105-inch- thick sheet metal, flush construction.
3. Frame: Minimum 0.105-inch- thick sheet metal with drywall or plaster bead.
4. Hinges: Concealed continuous piano.
5. Lock: Screw driver operated cam lock.
6. Finish: Use primed finish units in all painted surfaces including walls and ceilings, use baked finish in other non-painted surfaces such as ceramic/porcelain tile, metal panels, woodwork, and casework.

2.3 FABRICATION

A. General: Provide access door and frame 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. 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. For trimless frames with drywall bead, provide edge trim for gypsum board and gypsum base securely attached to perimeter of frames.
2. For trimless frames with plaster bead for full-bed plaster applications, provide zinc-coated expanded metal lath and exposed casing bead welded to perimeter of frames.
3. Provide mounting holes in frames for attachment of units to metal or wood framing.
4. Provide mounting holes in frame for attachment of masonry anchors. Furnish adjustable metal masonry anchors.

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing access 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 doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 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 083113

SECTION 083323 - OVERHEAD COILING DOORS

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. Service doors.
2. Insulated service doors.
3. Fire-rated service doors.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
3. Include description of automatic closing device and testing and resetting instructions.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
5. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
6. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

1. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:

1. Curtain slats.
2. Bottom bar.
3. Guides.
4. Brackets.
5. Hood.
6. Locking device(s).
7. Include similar Samples of accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Oversize Construction Certification: For door assemblies required to be fire-rated and that exceed size limitations of labeled assemblies.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
2. Smoke Control: , provide doors that are listed and labeled with the letter "S" on the fire-rating label by a qualified testing agency for smoke- and draft-control based on testing according to UL 1784; with maximum air-leakage rate of 3.0 cfm/sq. ft. of door opening at 0.10-inch wg for both ambient and elevated temperature tests.

C. Regulatory Requirements: Comply with applicable provisions in ICC A117.1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

1. Obtain operators and controls from overhead coiling door manufacturer.

2. 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. Cookson Company.
b. Cornell Iron Works, Inc.
c. Overhead Door Corporation.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Design Wind Load: As indicated on Drawings.
2. Testing: According to ASTM E 330.
3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
4. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.

2.3 SERVICE DOOR ASSEMBLY

A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

C. Air Infiltration: Maximum rate of 0.08 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E 283 or DASMA 105.

D. Door Curtain Material: Galvanized steel.

A. Door Curtain Slats: Curved profile slats of 1-7/8-inch to 2-5/8-inch center-to-center height.
1. Gasket Seal. Manufacturer's standard continuous gaskets between slats.

B. Bottom Bar: Two angles, fabricated from hot-dip galvanized steel and finished to match door.

C. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

D. Hood: Match curtain material and finish.

1. Shape: As shown on Drawings.
2. Mounting: As shown on Drawings.

E. Locking Devices: Equip door with locking device assembly.

1. Locking Device Assembly: Single-jamb side locking bars, operable from inside with thumb turn.

F. Manual Door Operator: Push-up operation.

G. Curtain Accessories: Equip door with weatherseals, astragal, push/pull handles and poll hook.

H. Door Finish:
1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.4 INSULATED SERVICE DOOR ASSEMBLY

A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

C. Air Infiltration: Maximum rate of 0.08 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E 283 or DASMA 105.

D. Curtain R-Value: 4.5 deg F x h x sq. ft./Btu.

E. Door Curtain Material: Galvanized steel.

F. Door Curtain Slats: Curved profile slats of 1-7/8-inch to 2-5/8-inch center-to-center height.
1. Gasket Seal. Manufacturer's standard continuous gaskets between slats.

G. Bottom Bar: Two angles, fabricated from hot-dip galvanized steel and finished to match door.

H. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

I. Hood: Match curtain material and finish.

1. Shape: As shown on Drawings.
2. Mounting: As shown on Drawings.

J. Locking Devices: Equip door with locking device assembly.

1. Locking Device Assembly: Single-jamb side locking bars, operable from inside with thumb turn.

K. Manual Door Operator: Push-up operation.

L. Curtain Accessories: Equip door with weatherseals, astragal, push/pull handles and poll hook.

M. Door Finish:
1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.5 FIRE-RATED DOOR ASSEMBLY

A. Fire-Rated Service Door: Overhead fire-rated coiling door formed with curtain of interlocking metal slats.

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. Cookson Company.
b. Cornell Iron Works, Inc.
c. Overhead Door Corporation.

B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

C. Fire Rating: 1-1/2 hours and with smoke control.

D. Door Curtain Material: Galvanized steel.

E. Door Curtain Slats: Curved profile slats of 1-7/8-inch to 2-5/8-inch center-to-center height.

F. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

G. Hood: Match curtain material and finish Galvanized steel.

1. Shape: As shown on Drawings.
2. Mounting: As shown on Drawings.

H. Electric Door Operator:

1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
2. Operator Location: As shown on Drawings.
3. Motor Exposure: Interior.
4. Emergency Manual Operation: Chain type.
5. Obstruction Detection Device: Automatic ; self-monitoring type.

6. Control Station(s): Where shown on Drawings.
7. Other Equipment: Audible and visual signals.

I. Curtain Accessories: Equip door with smoke seals, automatic closing device, astragal.

J. Door Finish:

1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.6 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.
2. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

2.8 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal 0.028-inch-thick, hot-dip galvanized steel sheet with G90 zinc coating, complying with ASTM A 653/A 653M.
2. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.

2.9 CURTAIN ACCESSORIES

A. Smoke Seals: Equip each fire-rated door with replaceable smoke-seal perimeter gaskets or brushes for smoke and draft control as required for door listing and labeling by a qualified testing agency.

B. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.

1. At door head, use 1/8-inch-thick, replaceable, continuous-sheet baffle secured to inside of hood or field- installed on the header.
2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch-thick seals of flexible vinyl, rubber, or neoprene.

C. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.

D. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

E. Automatic-Closing Device for Fire-Rated Doors: Equip each fire-rated door with an automatic-closing device or holder-release mechanism and governor unit complying with NFPA 80 and an easily tested and reset release mechanism. Release mechanism for motor- operated doors shall allow testing without mechanical release of the door. Automatic-closing device shall be designed for activation by the following:

1. Replaceable fusible links with temperature rise and melting point of 165 deg F interconnected and mounted on both sides of door opening.
2. Manufacturer's standard UL-labeled smoke detector and door-holder-release devices.
3. Manufacturer's standard UL-labeled heat detector and door-holder-release devices.
4. Building fire-detection, smoke-detection, and -alarm systems.

2.10 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic closing device operates.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.11 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door Operator Location(s): Operator location indicated for each door: as indicated on the drawings or required to fit in locations indicated.

D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.

1. Electrical Characteristics:

a. Phase: Single phase.
b. Volts: 115 V.
c. Hertz: 60.

2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
3. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel. For fire-rated doors, activation delays closing.

1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.

a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained or constant pressure on close button.

2. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

a. Self-Monitoring Type: Four-wire configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.

3. Pneumatic Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device.

G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."

1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
2. Exterior-Mounted Units: Full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.

H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.

2.12 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.13 STEEL AND GALVANIZED-STEEL FINISHES

A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

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

3.2 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

D. Fire-Rated Doors: Install according to NFPA 80.

E. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.

F. Power-Operated Doors: Install according to UL 325.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

1. Adjust exterior doors and components to be weather-resistant.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide tight fit around entire perimeter.

3.5 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include six months' full maintenance by skilled employees of coiling-door Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Perform maintenance, including emergency callback service, during normal working hours.
2. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

SECTION 084113 - ALUMINUM STOREFRONTS

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. Exterior and interior storefront systems.
2. Storefront framing for punched openings.

B. Related sections include the following:

1. Division 07 Section "Joint Sealants" for joint sealants installed as part of aluminum entrance and storefront systems.
2. Division 08 Section "Glazing."
3. Division 08 Section “Door Hardware”

1.3 SYSTEM DESCRIPTION

A. General: Provide aluminum entrance and storefront systems capable of withstanding loads and thermal and structural movement requirements indicated without failure, based on testing manufacturer's standard units in assemblies similar to those indicated for this Project. Failure includes the following:

1. Air infiltration and water penetration exceeding specified limits.
2. Framing members transferring stresses, including those caused by structural movement, to glazing units.

B. Glazing: Physically isolate glazing from framing members.

C. Dead Loads: Provide entrance- and storefront-system members that do not deflect an amount which will reduce glazing bite below 75 percent of design dimension when carrying full dead load.

1. Provide a minimum 1/8-inch clearance between members and top of glazing or other fixed part immediately below.
2. Provide a minimum 1/16-inch clearance between members and operable windows and doors.

D. Live Loads: Provide entrance and storefront systems, including anchorage, that accommodate the supporting structures' deflection from uniformly distributed and concentrated live loads indicated without failure of materials or permanent deformation.

E. Air Infiltration: Provide entrance and storefront systems with permanent resistance to air leakage through fixed glazing and frame areas of not more than 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a static-air-pressure difference of 1.57 lbf/sq. ft.

F. Structural-Support Movement: Provide entrance and storefront systems that accommodate structural movements including, but not limited to, sway and deflection.

G. Dimensional Tolerances: Provide entrance and storefront systems that accommodate dimensional tolerances of building frame and other adjacent construction.

H. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 60 when tested according to AAMA 1503.

I. Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.45 Btu/sq. ft. x h x deg F when tested according to AAMA 1503.

J. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
   a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
   b. Low Exterior Ambient-Air Temperature: 0 deg F.

1.4 SUBMITTALS

A. Product Data: For each product specified. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes.

B. Shop Drawings: For entrance and storefront systems. Show details of fabrication and installation, including plans, elevations, sections, details of components, provisions for expansion and contraction, and attachments to other work.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer to assume engineering responsibility and perform work of this Section who has specialized in installing entrance and storefront systems similar to those required for this Project and who is acceptable to manufacturer.

1. Engineering Responsibility: Prepare data for entrance and storefront systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Source Limitations: Obtain each type of entrance and storefront system through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of entrance and storefront systems and are based on the specific systems indicated. Other manufacturers'

systems with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."

1. Do not modify intended aesthetic effect, as judged solely by Architect, except with Architect's approval and only to the extent needed to comply with performance requirements. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

D. Welding Standards: Comply with applicable provisions of AWS D1.2, "Structural Welding Code--Aluminum."

1.6 PROJECT CONDITIONS

A. Field Measurements: 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 systems without field measurements. Coordinate construction to ensure actual dimensions correspond to established dimensions.

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. Special Warranty: Submit a written warranty executed by the manufacturer agreeing to repair or replace components of entrance and storefront systems that fail in materials or workmanship within the specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including, but not limited to, excessive deflection.
   b. Adhesive sealant failures.
   c. Cohesive sealant failures.
   d. Failure of system to meet performance requirements.
   e. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   f. Failure of operating components to function normally.
   g. Water leakage through fixed glazing and frame areas.

2. Warranty Period: 10 years from date of Substantial Completion.

C. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: 20 years from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

A. Entrance Door Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

1. Kawneer Company, Inc.
2. Arch Amarlite.
3. EFCO Corporation.
4. International Aluminum Corporation; U.S. Aluminum.
5. Tubelite Architectural Systems.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with the requirements of standards indicated below.

1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221 (ASTM B221M).
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Bars, Rods, and Wire: ASTM B 211(ASTM B 211M)
5. Welding Rods and Bare Electrodes: AWS A5.10.

B. Steel Reinforcement: Complying with ASTM A 36(ASTM A 36M) for structural shapes, plates, and bars; ASTM A 611 for cold-rolled sheet and strip; or ASTM A 570(ASTM A 570M) for hot-rolled sheet and strip.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken for exterior units.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: As indicated.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.

E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Division 08 Section "Glazing."

B. Spacers, Setting Blocks, Gaskets, and Bond Breakers: Manufacturer's standard permanent, non-migrating types in hardness recommended by manufacturer, compatible with sealants, and suitable for system performance requirements.

1. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; single-component neutral-curing formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and aluminum-framed-system manufacturers for this use.

C. Glazing as specified in Division 8 Section "Glazing."

D. Glazing Gaskets: Manufacturer's standard pressure-glazing system, resilient glazing gaskets, setting blocks, and shims or spacers, fabricated from an elastomer of type and in hardness recommended by system and gasket manufacturer to comply with system performance requirements. Provide gasket assemblies that have corners sealed with sealant recommended by gasket manufacturer.

E. Secondary Sealant: For use as weatherseal, compatible with structural silicone sealant and other system components with which it comes in contact, and that accommodates a 50 percent increase or decrease in joint width at the time of application when measured according to ASTM C 719.

1. Color: As selected by Architect from manufacturer's full range of colors.
2. Use neutral-cure silicone sealant with insulating-glass units.

F. Framing system gaskets, sealants, and joint fillers as recommended by manufacturer for joint type.

G. Sealants and joint fillers for joints at perimeter of entrance and storefront systems as specified in Division 7 Section "Joint Sealants."

H. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements, except containing no asbestos, formulated for 30-mil thickness per coat.

2.5 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

D. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color: Clear Anodized

2.6 STEEL PRIMING

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying primer.

B. Surface Preparation: Perform manufacturer's standard cleaning operations to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel.

C. Priming: Apply manufacturer's standard corrosion-resistant primer immediately after surface preparation and pretreatment.

2.7 FABRICATION

A. General: Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

1. Fabricate components for screw-spline frame construction.
2. Exterior units to be thermally broken.
3. Coordinate and provide concealed pathways for openings scheduled to receive electrified hardware

B. Forming: Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.

C. Prepare components to receive concealed fasteners and anchor and connection devices.

D. Fabricate components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior.

E. Welding: Weld components to comply with referenced AWS standard. Weld before finishing components to greatest extent possible. Weld in concealed locations to greatest extent possible

to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

F. Glazing Channels: Provide minimum clearances for thickness and type of glass indicated according to FGMA's "Glazing Manual."

G. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

H. Storefront: Fabricate framing in profiles indicated for flush glazing (without projecting stops). Provide subframes and reinforcing of types indicated or, if not indicated, as required for a complete system. Factory assemble components to greatest extent possible. Disassemble components only as necessary for shipment and installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of entrance and storefront systems. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions for protecting, handling, and installing entrance and storefront systems. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure non-movement joints. Seal joints air and watertight.

B. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in a full sealant bed to provide airtight construction, unless otherwise indicated. Comply with requirements of Division 7 Section "Joint Sealants."

D. Install framing components plumb and true in alignment with established lines and grades without warp or rack of framing members.

E. Provide the following items: Thresholds, sweeps, continuous gear hinges, and weatherstripping to meet manufacturer’s warranty requirements.

F. Install glazing to comply with requirements of Division 8 Section "Glazing," unless otherwise indicated.

1. Remove excess sealant from component surfaces before sealant has cured.

G. Install perimeter sealant to comply with requirements of Division 7 Section "Joint Sealants," unless otherwise indicated.

H. Erection Tolerances: Install entrance and storefront systems to comply with the following maximum tolerances:

1. Variation from Plane: Limit variation from plane or location shown to 1/8 inch in 12 feet; 1/4 inch over total length.
2. Alignment: Where surfaces abut in line, limit offset from true alignment to 1/16 inch. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
3. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

3.3 ADJUSTING AND CLEANING

A. Remove excess sealant and glazing compounds, and dirt from surfaces.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure entrance and storefront systems are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 084113

SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

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 glazed aluminum curtain walls.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain walls and for sealants to the extent not specified in this Section.
2. Section 084413 "Aluminum Framed Entrances and Storefronts" for coordinating finish among aluminum fenestration units.
3. Section 088000 "Glazing".

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:

a. Joinery, including concealed welds.
b. Anchorage.
c. Expansion provisions.
d. Glazing.
e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Delegated-Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Preconstruction Laboratory Mockup Testing Submittals:

1. Testing Program: Developed specifically for Project.
2. Test Reports: Prepared by a qualified preconstruction testing agency for each mockup test.
3. Record Drawings: As-built drawings of preconstruction laboratory mockups showing changes made during preconstruction laboratory mockup testing.

B. Qualification Data: For Installer.

C. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.

D. Product Test Reports: For glazed aluminum curtain walls, for tests performed by a qualified testing agency.

E. Quality-Control Program: Developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C 1401. Include periodic quality-control reports.

F. Source quality-control reports.

G. Field quality-control reports.

H. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

B. Maintenance Data for Structural Sealant: For structural-sealant-glazed curtain walls to include in maintenance manuals. Include ASTM C 1401 recommendations for post-installation-phase quality-control program.

1.7 QUALITY ASSURANCE

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

B. Laboratory Mockup Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025..

C. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.

D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

E. Structural-Sealant Glazing: Comply with ASTM C 1401 for design and installation of curtain wall assemblies.

1.8 MOCKUPS

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 WARRANTY

A. Special Assembly Warranty: Manufacturer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration created by wind and thermal and structural movements.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
d. Water penetration through fixed glazing and framing areas.

e. Failure of operating components.

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

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazed aluminum curtain walls.

B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

C. Structural Loads:

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

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

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.

3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:

    a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4-inch for spans greater than 11 feet 8-1/4 inches or 1/175 times span, for spans less than 11 feet 8-1/4 inches.

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

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

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

1. Fixed Framing and Glass Area:

    a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..

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

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

H. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
2. Maximum Water Leakage: According to AAMA 501.1. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.

I. Interstory Drift: Accommodate design displacement of adjacent stories indicated.

1. Design Displacement: As indicated on Drawings.
2. Test Performance: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement and 1.5 times the design displacement.

J. Seismic Performance: Glazed aluminum curtain walls shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.6 at design displacement and 1.5 times the design displacement.
2. Vertical Interstory Movement: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.7 at design displacement and 1.5 times the design displacement.

K. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.57 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.35 as determined according to NFRC 200.
3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 45 as determined according to NFRC 500.

L. Noise Reduction: Test according to ASTM E 90, with ratings determined by ASTM E 1332, as follows:

1. Outdoor-Indoor Transmission Class: Minimum 34.

M. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

    a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
    b. Low Exterior Ambient-Air Temperature: 0 deg F.

N. Structural-Sealant Joints:

1. Designed to carry gravity loads of glazing.
2. Designed to produce tensile or shear stress of less than 20 psi.

O. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed curtain walls without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.

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

2.2 MANUFACTURERS

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

1. EFCO Corporation.
2. Kawneer North America; an Alcoa company.
3. Oldcastle, Inc.
4. TRACO.
5. YKK AP America Inc.

B. Source Limitations: Obtain all components of curtain wall system, including framing entrances and accessories, from single manufacturer.

2.3 FRAMING

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Front.
4. Finish: Clear anodic finish.
5. Fabrication Method: Either factory- or field-fabricated system.

B. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

a. Sheet and Plate: ASTM B 209.
b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
d. Structural Profiles: ASTM B 308/B 308M.

2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 ENTRANCES

A. Entrances: Comply with Section 084113 "Aluminum-Framed Entrances and Storefronts."

2.5 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

D. Structural Glazing Sealants: ASTM C 1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in curtain-wall assembly indicated.

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

E. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed curtain-wall manufacturers for this use.

1. Color: Match structural sealant.

2.6 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
7. Components curved to indicated radii.

D. Fabricate components to resist water penetration as follows:

1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

E. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method.

F. Factory-Assembled Frame Units:

1. Rigidly secure nonmovement joints.
2. Prepare surfaces that are in contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion.
3. Preparation includes, but is not limited to, cleaning and priming surfaces.
4. Seal joints watertight unless otherwise indicated.
5. Install glazing to comply with requirements in Section 088000 "Glazing."

G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.9 SOURCE QUALITY CONTROL

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 PREPARATION

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

3.3 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

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

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

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

E. Install glazing as specified in Section 088000 "Glazing."

1. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

F. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

3.4 ERECTION TOLERANCES

A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:

    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
    b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Test Area: Perform tests on representative areas of glazed aluminum curtain walls.

C. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

    a. Perform a minimum of two tests in areas as directed by Architect.
    b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to.

2. Air Infiltration: ASTM E 783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..

    a. Perform a minimum of two tests in areas as directed by Architect.
    b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to.

3. Water Penetration: ASTM E 1105 at a minimum uniform static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and shall not evidence water penetration.

D. Structural-Sealant Adhesion: Test structural sealant according to recommendations in ASTM C 1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.

1. Test a minimum of two areas on each building facade.
2. Repair installation areas damaged by testing.

E. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 084413

SECTION 08711 - 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 the following:

a. Swinging doors.
b. Other doors to the extent indicated.

2. Cylinders for doors specified in other Sections.
3. Electrified door hardware.

B. Related Sections include the following:

1. Division 08 Section "Hollow Metal Doors and Frames".
2. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
3. Division 16 Sections for connections to electrical power system and for low-voltage wiring work.
4. Division 16 Section "Access Control" for access control devices installed at door openings and provided as part of a security access system.

1.3 SUBMITTALS

A. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples for Initial Selection: For each finish, color, and texture required for each type of door hardware indicated.

C. Samples for Verification: For exposed door hardware of each type, in specified finish, full size. Tag with full description for coordination with the door hardware sets. Submit Samples before, or concurrent with, submission of the final door hardware sets.

1. Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.

D. Product Certificates: For electrified door hardware, signed by product manufacturer.

1. Certify that door hardware approved for use on types and sizes of labeled fire doors complies with listed fire door assemblies.

E. Qualification Data: For Installer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for locks latches delayed-egress locks and closers.

G. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

H. Warranty: Special warranty specified in this Section.

I. Other Action Submittals:

1. Door Hardware Sets: Prepared by or under the supervision of Installer, 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.

a. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.
b. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
c. Content: Include the following information:

1) Identification number, location, hand, fire rating, and material of each door and frame.
2) Type, style, function, size, quantity, and finish of each door hardware item. Include description and function of each lockset and exit device.
3) Complete designations of every item required for each door or opening including name and manufacturer.
4) Fastenings and other pertinent information.
5) Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
6) Explanation of abbreviations, symbols, and codes contained in schedule.
7) Mounting locations for door hardware.
8) Door and frame sizes and materials.
9) Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.

a) Sequence of Operation: Include description of component functions that occur in the following situations: authorized person wants to enter; authorized person wants to exit; unauthorized person wants to enter; unauthorized person wants to exit.

10) Riser diagrams for electrified door hardware openings, showing conduit runs and hardware locations.
11) Point to point wiring diagrams for door hardware openings, showing wire size.

12) List of related door devices specified in other Sections for each door and frame.

d. 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.

e. Submittal Sequence: Submit initial draft of final schedule along with essential Product Data to facilitate the fabrication of other work that is critical in Project construction schedule. Submit the final door hardware sets after Samples, Product Data, coordination with Shop Drawings of other work, delivery schedules, and similar information has been completed and accepted.

2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

1.4 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.
4. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

1. Electrified Door Hardware Consultant Qualifications: A qualified Architectural Hardware Consultant who is experienced in providing consulting services for electrified door hardware installations.

C. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

D. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

1. Test Pressure: Test at atmospheric pressure.

E. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

F. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:

1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
2. Preliminary key system schematic diagram.
3. Address for delivery of keys.

1.5 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 by registered mail or overnight package service.

1.6 COORDINATION

A. Coordinate layout and installation of recessed closers with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

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

D. Existing Openings: Where new hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide for proper operation.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection, cracking, or breakage.
b. Faulty operation of operators and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
d. Warranty Period: Five years from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

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

1.9 EXTRA MATERIALS

A. Furnish full-size units of door hardware described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Door Hardware: One mortise lockset,
2. Electrical Parts: One extra power supply for electrically operated locksets.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in this Section and door hardware Schedule at the end of Part 3.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated.
2. Sequence of Operations: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

B. 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 the manufacturers specified.

2.2 HINGES, GENERAL

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

1. Two Hinges: For doors with heights up to 60 inches.
2. Three Hinges: For doors with heights 61 to 90 inches.
3. Four Hinges: For doors with heights 91 to 120 inches.
4. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

B. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

C. Hinge Weight: Unless otherwise indicated, provide the following:

1. Entrance Doors: Heavy-weight hinges.
2. Exterior Doors: Heavy-weight hinges.
3. Doors with Closers: Antifriction-bearing hinges.
4. Interior Doors: Antifriction-bearing hinges.

D. Hinge Base Metal: Unless otherwise indicated, provide the following:

1. Exterior Hinges: Stainless steel, with stainless-steel pin.
2. Interior Hinges: Steel, with steel pin.
3. Hinges for Fire-Rated Assemblies: Steel, with steel pin.

E. Hinge Options: Where indicated in door hardware sets or on Drawings:

1. Button Tips: Flat ends of hinge barrel.
2. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for outswinging exterior doors and outswinging corridor doors with locks.
3. Corners: Square.

F. Fasteners: Comply with the following:

1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
2. Wood Screws: For wood doors and frames.
3. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.
4. Screws: Phillips flat-head; machine screws (drilled and tapped holes) for metal doors wood screws for wood doors and frames. Finish screw heads to match surface of hinges.

2.3 HINGES

A. Template Hinge Dimensions: BHMA A156.7.

B. Manufacturers:

1. Baldwin Hardware Corporation.
2. Hager Companies.
3. McKinney Products Company; an ASSA ABLOY Group company.
4. Stanley Commercial Hardware; Div. of The Stanley Works.
5. Ives, an Ingersoll-Rand Co.

C. Plain-Bearing, Standard-Weight, Full-Mortise (Butt) Hinges: BHMA A156.1, Grade 3, button tips, nonrising removable pins, and base metal as follows:

1. Base Metal: Stainless steel.

2.4 LOCKS AND LATCHES, GENERAL

A. Acceptable Manufacturers:

a. Best Locks.
b. Corbin Russwin Locks.
c. Sargent Locks.
d. Yale Locks.
e. Schlage Locks.

B. Accessibility Requirements: Where indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22 N).

C. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf (67 N) to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.

D. Electrified Locking Devices: BHMA A156.25.

E. Lock Trim:

1. Levers: Forged or Cast.
2. Escutcheons (Roses): Wrought, Forged, or Cast.
3. Dummy Trim: Match lever lock trim and escutcheons.
4. Lockset Designs: Sargent “L” lever. Provide design indicated in Part 3 or, if sets are provided by another manufacturer, provide designs that match those designated.

F. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.

2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
3. Deadbolts: Minimum 1-inch (25-mm) bolt throw.

G. Backset: 2-3/4 inches (70 mm), unless otherwise indicated.

H. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, and as follows:

1. Strikes for Bored Locks and Latches: BHMA A156.2.
2. Strikes for Mortise Locks and Latches: BHMA A156.13.
3. Strikes for Auxiliary Deadlocks: BHMA A156.5.
4. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
5. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
6. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.

2.5 EXIT DEVICES, GENERAL

A. Exit Devices: BHMA A156.3, Grade 1.

B. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22 N).

C. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15 lbf (67 N) to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.

D. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

E. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.

F. Fire-Exit Removable Mullions: Provide removable mullions for use with fire exit devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252. Mullions shall be used only with exit devices for which they have been tested.

G. Outside Trim: Lever with cylinder; material and finish to match locksets, unless otherwise indicated.

1. Match design for locksets and latchsets, unless otherwise indicated.

H. Available Manufacturers:
1. Corbin Russwin Architectural Hardware.
2. SARGENT Manufacturing Company.
3. Von Duprin.
4. Yale Commercial Locks and Hardware.
5. Stanley Works Co.

2.6 LOCK CYLINDERS

A. Standard Lock Cylinders: BHMA A156.5, Grade 1.

B. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:

1. Number of Pins: Seven.
2. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
3. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
4. Bored-Lock Type: Cylinders with tailpieces to suit locks.

a. High-Security Grade: BHMA A156.5, Grade 1A, listed and labeled as complying with pick- and drill-resistant testing requirements in UL 437 (Suffix A).

C. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:

1. Interchangeable Cores: Core insert, removable by use of a special key; usable with other manufacturers' cylinders.
2. Removable Cores: Core insert, removable by use of a special key; for use only with core manufacturer's cylinder and door hardware.

D. Construction Keying: Comply with the following:

1. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
2. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

a. Replace construction cores with permanent cores as directed by Owner.
b. Furnish permanent cores to Owner for installation.

E. Manufacturer: Same manufacturer as for locks and latches.

2.7 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference, and as follows:

1. Great-Grand Master Key System: Cylinders are operated by a change key, a master key, a grand master key, and a great-grand master key.

B. Keys: Nickel silver.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: Information to be furnished by Owner.

2. Quantity: In addition to one extra key blank for each lock, provide the following:

a. Cylinder Change Keys: Three.
b. Master Keys: Five.
c. Grand Master Keys: Five.
d. Great-Grand Master Keys: Five.

2.8 CLOSERS

A. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1. Comply with the following maximum opening-force requirements:

a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf (133 N) to set door in motion and not more than 15 lbf (67 N) to open door to minimum required width.

C. Hold-Open Closers/Detectors: Coordinate and interface integral smoke detector and closer device with fire alarm system.

D. Flush Floor Plates: Provide finish cover plates for floor closers unless thresholds are indicated. Match door hardware finish, unless otherwise indicated.

E. Recessed Floor Plates: Provide recessed floor plates with insert of floor finish material for floor closers unless thresholds are indicated. Provide extended closer spindle to accommodate thickness of floor finish.

F. Power-Assist Closers: As specified in Division 08 Section "Automatic Door Operators" for access doors for people with disabilities or where listed in door hardware sets.

G. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

H. Surface Closers: BHMA A156.4, Grade 1.Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated.

1. Available Manufacturers:
   a. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
   b. LCN Closers; an Ingersoll-Rand Company.
   c. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
   d. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company.
   e. Stanley Works Co.

2.9 PROTECTIVE TRIM UNITS, GENERAL

A. Size: 1-1/2 inches (38 mm) less than door width on push side and 1/2 inch (13 mm) less than door width on pull side, by height specified in door hardware sets.

B. Fasteners: Manufacturer's standard machine or self-tapping screws.

C. Metal Protective Trim Units: BHMA A156.6; beveled top and 2 sides; fabricated from the following material:

1. Material: 0.050-inch- (1.3-mm-) thick stainless steel.
2. Available Manufacturers:
   a. Baldwin Hardware Corporation.
   b. Hager Companies.
   c. IVES Hardware; an Ingersoll-Rand Company.
   d. Rockwood Manufacturing Company.

2.10 PROTECTIVE TRIM UNITS

A. Kick Plates: 10 inches high by door width, with allowance for frame stops.

B. Mop Plates: 4 inches high by 1 inch (25 mm) less than door width.

2.11 STOPS AND HOLDERS, GENERAL

A. Stops and Bumpers: BHMA A156.16, Grade 1.

1. Provide floor stops for doors unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.

B. Silencers for Wood Door Frames: BHMA A156.16, Grade 1; neoprene or rubber, minimum 5/8 by 3/4 inch (16 by 19 mm); fabricated for drilled-in application to frame.

C. Silencers for Metal Door Frames: BHMA A156.16, Grade 1; neoprene or rubber, minimum diameter 1/2 inch (13 mm); fabricated for drilled-in application to frame.

2.12 STOPS AND HOLDERS

A. Wall Bumpers: Polished cast brass or aluminum with rubber bumper; 2-1/2-inch (64-mm) diameter, minimum 3/4-inch (19-mm) projection from wall, with backplate for concealed fastener installation; with convex bumper configuration.

B. Rigid Floor Stops: Polished cast brass, bronze, or aluminum, with rubber bumper; surface-screw application.

2.13 THRESHOLDS

A. Standard: BHMA A156.21.

B. Accessibility Requirements: Where thresholds are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.

C. Thresholds for Means of Egress Doors: Comply with NFPA 101. Maximum 1/2 inch (13 mm) high.

D. Manufacturers:

1. Hager Companies.
2. M-D Building Products, Inc.
3. McKinney; an ASSA ABLOY Group company.
4. National Guard Products.
5. Pemko Manufacturing Co.
6. Reese Enterprises.
7. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
8. Sealeze; a Unit of Jason Incorporated.
9. Zero International.

2.14 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.

C. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to

commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Steel Machine or Wood Screws: For the following fire-rated applications:

    a. Mortise hinges to doors.
    b. Strike plates to frames.
    c. Closers to doors and frames.

3. Steel Through Bolts: For the following fire-rated applications unless door blocking is provided:

    a. Closers to doors and frames.
    b. Surface-mounted exit devices.

4. Spacers or Sex Bolts: For through bolting of hollow-metal doors.

2.15 FINISHES

A. Standard: To be verified.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. The designations used in schedules and elsewhere to indicate hardware finishes are the industry-recognized standard commercial finishes, except as otherwise noted.

1. Satin Chromium Plated, Clear Powder Coated: US26D/ANSI 626, ANSI 652 at locksets, hinges, and cylinders unless otherwise noted.
2. Brushed Stainless Steel, no coating: US32D/ANSI 630 at, latches, exit devices, protective plates, door pulls, and wall stops unless otherwise noted.
3. Powder Coated Aluminum finish: ANSI 689, for door closers, unless otherwise noted.
4. Anodized aluminum finish: US28/ANSI 628, for continuous hinges, and weatherseal. 130 indicates satin aluminum finish.
5. Mill aluminum finish: US28/ANSI 628, for thresholds.

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

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

3.2 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. Mounting Heights: Mount door hardware units at heights indicated on Drawings 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."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work 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.

C. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings, or in equipment room. Verify location with Architect.

1. Configuration: Provide one power supply for each door opening.
2. Configuration: Provide the least number of power supplies required to adequately serve doors with electrified door hardware.

D. 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. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 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. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
2. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 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 HARDWARE SETS

A. Manufacturer specified in hardware schedule:

1. **Adams Rite** (AR) – Deadlatches, paddles and pulls for aluminum door hardware.
2. **Corbin Russwin** (CR) – Dummy Cylinder.

3. **McKinney** (MC) – Hinges, flush bolts, door pulls, push plate, protection plate, door holder, wall stop, dust proof strike, door silencers.
4. **Pemko** (PE) – Smoke seal, astragal, rain drip, weatherstrip, automatic door bottom, thresholds.
5. **Rixson** (RX) – Pivots, overhead stop.
6. **Sargent** (SA) - Closers, low energy automatic operator, automatic operator wall actuators, locksets, removable mullions, exit devices, deadlocks, dummy push/pull sets, cylinders, power supply/controller for exit devices
7. **Von Duprin** (VD) - Closers, low energy automatic operator, automatic operator wall actuators, locksets, removable mullions, exit devices, deadlocks, dummy push/pull sets, cylinders, power supply/controller for exit devices

B. Abbreviations used in hardware schedule:

1. ALD – Aluminum Door
2. DH – Door Height
3. DT – Dummy Trim
4. DW – Door Width
5. FHSL25 –Flat Head Sleeve Anchor
6. FW – overall frame width
7. HMD – Hollow Metal Door
8. H+J – Head and Jamb
9. LDW – Less door width
10. NL – Night Latch
11. NRP – Non rising pin
12. OW – Opening width
13. PA – parallel arm mount
14. Reg – Regular arm mount
15. TEK – self drilling #6 sheet metal screws
16. TJ – top jamb mount
17. WDD – Wood Door

Hardware Sets

SET #1 – Pair of exterior, hollow metal, egress doors
Door: 146A, 146C
Exit/Panic Hardware, final schedule forthcoming.

SET #2 – Pair of interior, hollow metal, egress doors
Door: 146B
Exit/Panic Hardware, final schedule forthcoming.

SET #3 – Single exterior, hollow metal, egress doors
Door: 160A
Exit/Panic Hardware, final schedule forthcoming.

SET #4 – Pair of interior, hollow metal, storage door
Door: 148A
Storage Hardware, final schedule forthcoming.

SET #5 – Single interior, hollow metal, office door

Door: 147, 149

Office/Classroom Hardware, final schedule forthcoming.

END OF SECTION 08711

SECTION 088000 - GLAZING

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 glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows.
2. Doors.
3. Glazed entrances.
4. Storefront framing.

B. Related Sections include the following:

1. Division 08 Windows and Doors Sections

1.3 DEFINITIONS

A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

E. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

F. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for

maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed industry standards for applications indicated.

C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient temperatures acting on glass framing members and glazing components.

1. Temperature Change (Range): 60 deg F, ambient

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.6 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

C. Warranties: Special warranties specified in this Section.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

B. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type.

C. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

D. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201 and, for wired glass, ANSI Z97.1.

1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency or manufacturer acceptable to authorities having jurisdiction.
2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

E. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA Laminated Division's "Laminated Glass Design Guide" and GANA's "Glazing Manual."
2. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Sloped Glazing Guidelines."
3. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."

F. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:

1. Insulating Glass Certification Council.
2. Associated Laboratories, Inc.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.10 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form, made out to Owner and signed by laminated-glass manufacturer agreeing to replace laminated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

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

C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS

A. Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), Quality-Q3; of class indicated.

B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
2. Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
3. For uncoated glass, comply with requirements for Condition A.
4. For coated vision glass, comply with requirements for Condition C (other uncoated glass).
5. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is indicated.

C. Laminated glass, ASTM C 1172. Use materials that have a proven record of not bubbling, discoloring, or losing physical and mechanical properties after fabrication and installation.

1. Comply with requirements for safety glazing.

D. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.

1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
2. Provide Kind FT (fully tempered) glass lites where safety glass is indicated or required by the building code.
3. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
4. Sealing System: Dual seal, with primary and secondary sealants as follows:

    a. Polyisobutylene and silicone

5. Spacer Specifications: Aluminum with mill or clear anodic finish..

2.2 GLAZING GASKETS

A. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:

1. Neoprene.
2. EPDM.
3. Silicone.
4. Thermoplastic polyolefin rubber.
5. Any material indicated above.

2.3 GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Single-Component Neutral- and Basic-Curing Silicone Glazing Sealants:

a. Available Products:

1) GE Silicones; SilPruf SCS2000.
2) Pecora Corporation; 864.
3) Pecora Corporation; 890.
4) Polymeric Systems Inc.; PSI-641.
5) Sonneborn, Div. of ChemRex, Inc.; Omniseal.
6) Tremco; Spectrem 3.

b. Type and Grade: S (single component) and NS (nonsag).
c. Use Related to Exposure: NT (nontraffic).
d. Uses Related to Glazing Substrates: M, G, A, and, as applicable to glazing substrates indicated, O.

1) Use O Glazing Substrates: Coated glass color, anodic aluminum.

2. Neutral-Curing Silicone Glazing Sealants:

a. Available Products:

1) Dow Corning Corporation; 791.
2) Dow Corning Corporation; 795.
3) GE Silicones; SilPruf NB SCS9000.
4) GE Silicones; UltraPruf II SCS2900.
5) Pecora Corporation; 865.
6) Pecora Corporation; 895.
7) Pecora Corporation; 898.

b. Type and Grade: S (single component) and NS (nonsag).
c. Class: 50.
d. Use Related to Exposure: NT (nontraffic).
e. Uses Related to Glazing Substrates: M, G, A, and, as applicable to glazing substrates indicated, O.

1) Use O Glazing Substrates: Coated glass clear anodic aluminum.

C. Glazing Sealants for Fire-Resistive Glazing Products: Identical to products used in test assemblies to obtain fire-protection rating.

2.4 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:

1. Type 1, for glazing applications in which tape acts as the primary sealant.
2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.5 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

G. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

2.6 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with outdoor and indoor faces.

C. Grind smooth and polish exposed glass edges and corners.

2.7 EXTERIOR INSULATING-GLASS UNITS (G1)

A. Solar Control Low-E Clear Low-Glare Insulating-Glass Units (fully tempered)

1. Basis-of-Design Product: Subject to compliance with requirements, provide Guardian Industries Corp.; SunGuard SN 54 or equal:
2. Overall Unit Thickness and Thickness of Each Lite: 25 and 6.0 mm.
3. Interspace Content: Air.
4. Outdoor Lite: Class 1 (clear) Type 1 (transparent glass, flat) float glass.
5. Indoor Lite: Class 1 (clear) Type 1 (transparent glass, flat) float glass.
6. Low-E Coating: Sputtered on second surface. SunGuard SuperNeutral (SN-54) or Equal
7. Visible Light Transmittance: 54 percent maximum
8. Solar Energy Transmittance: 23 percent maximum
9. U-V transmittance: 15 percent maximum
10. Visible Light Reflectance Exterior: 13 percent maximum
11. Visible Light Reflectance Interior: 18 percent maximum
12. Solar Energy Reflectance: 33 percent maximum
13. Winter Nighttime U-Factor: 0.29 maximum.
14. Summer Daytime U-Factor: 0.27 maximum.
15. Solar Heat Gain Coefficient: 0.28 maximum.
16. Shading Coefficient: 0.32 maximum
17. Relative Heat Gain: 68 maximum
18. Edge Seals: ASTM E 773, with aluminum spacers and silicone sealant for glass-to-spacer seals.
19. Sealant: Approved by glass manufacturer.

2.8 MONOLITHIC FLOAT-GLASS UNITS (G2)

A. Uncoated Clear Float-Glass Units: Class 1 (clear) Kind FT (fully tempered) float glass.

1. Thickness: 6.0 mm.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.

2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Effective sealing between joints of glass-framing members.

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

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

A. Protect glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

SECTION 089000 - 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fixed, extruded-aluminum louvers.

B. Related Sections:
1. Division 23 Sections for louvers that are a part of mechanical equipment.

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. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

C. 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.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of metal finish required.

E. Delegated-Design Submittal: For louvers indicated to comply with structural and seismic performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. 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. Galvanized-Steel Sheet: ASTM A 653/A 653M, G60 zinc coating, mill phosphatized.

E. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use tamper-resistant 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.

F. 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.

G. 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. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.

1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern unless horizontal mullions are indicated.
2. Horizontal Mullions: Provide horizontal mullions at joints unless continuous vertical assemblies are indicated.

C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: Channel unless otherwise indicated.

E. Include supports, anchorages, and accessories required for complete assembly.

F. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches o.c., whichever is less.

1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
2. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
3. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
4. Exterior Corners: Prefabricated corner units with mitered and welded blades and with semirecessed mullions at corners.

G. Provide subsills made of same material as louvers or extended sills for recessed louvers.

H. Join frame members to each other and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Sightproof, Drainable-Blade Louver:

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

a. Air Balance Inc.; a Mestek company.
b. Airolite Company, LLC
c. Ruskin Company; Tomkins PLC.

2. Louver Depth: 6 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
4. Mullion Type: Semirecessed.
5. Louver Performance Ratings:

a. Free Area: Not less than 8.3 sq. ft. for 48-inch-wide by 48-inch-high louver.

b. Water Penetration: shall be no more than 0.003 ounces of water per square foot of free area when tested for 15 minutes at 1100 FPM per AMCA Standard 500.
c. Air Performance: Not more than 0.15-inch wg static pressure drop at 1100-fpm free-area intake velocity.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Bird screening.

B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same kind and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type: Rewirable frames with a driven spline or insert.

D. Louver Screening for Aluminum Louvers:

1. Bird Screening: Aluminum, 1/2-inch-square mesh, 0.063-inch wire.

2.5 FINISHES, GENERAL

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

2.6 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

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

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 07 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 089000

SECTION 092900 - GYPSUM BOARD ASSEMBLIES

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. Interior gypsum wallboard.
2. Non-load-bearing steel framing.
3. Tile backing panels

B. Related Sections include the following:

1. Division 07 Section "Building Insulation" for insulation and vapor retarders installed in gypsum board assemblies.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

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

B. Shop Drawings: Show locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.

C. Samples: For the following products:

1. Trim Accessories: Full-size sample in 12 inch long length for each trim accessory indicated.
2. Textured Finishes: Manufacturer's standard size for each textured finish indicated and on same backing indicated for Work.

1.5 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL’s “Fire Resistance Directory”.

B. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

1. STC-Rated Assemblies: Indicated by design designations from GA-600, "Fire Resistance Design Manual".

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Steel Framing and Furring:

a. Clark Steel Framing Systems.
b. Consolidated Systems, Inc.
c. Dale Industries, Inc. - Dale/Incor.
d. Dietrich Industries, Inc.
e. MarinoWare; Division of Ware Ind.
f. National Gypsum Company.
g. Scafco Corporation.
h. Unimast, Inc.
i. Western Metal Lath & Steel Framing Systems.

2. Gypsum Board and Related Products:

a. American Gypsum Co.
b. G-P Gypsum Corp.
c. National Gypsum Company.
d. United States Gypsum Co.

2.2 STEEL SUSPENDED CEILING AND SOFFIT FRAMING

A. Components, General: Comply with ASTM C 754 for conditions indicated.

B. Furring Channels (Furring Members): Commercial-steel sheet with manufacturer's standard corrosion-resistant zinc coating.

1. Steel Studs: ASTM C 645.

2. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.

2.3 STEEL PARTITION AND SOFFIT FRAMING

A. Components, General: As follows:

1. Comply with ASTM C 754 for conditions indicated.
2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with manufacturer's standard corrosion-resistant zinc coating.

B. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

C. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.4 INTERIOR GYPSUM WALLBOARD

A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

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. American Gypsum Co.
b. BPB America Inc.
c. G-P Gypsum.
d. Lafarge North America Inc.
e. National Gypsum Company.
f. PABCO Gypsum.
g. Temple.
h. USG Corporation.

C. Regular Type:

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

D. Type X:

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

E. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.

1. Thickness: 1/2 inch.
2. Long Edges: Tapered.

F. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.

G. Abuse-Resistant Gypsum Board: ASTM C 1629/C 1629M, Level 1.

1) Core: 5/8 inch, Type X.
2) Long Edges: Tapered.
3) Mold Resistance: ASTM D 3273, score of 10.

2.5 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9.

B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Custom Building Products; Wonderboard.
2. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
3. USG Corporation; DUROCK Cement Board.

C. Thickness: 5/8 inch.

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:

a. Cornerbead: Use at outside corners.
b. LC-Bead: J-shaped; exposed long flange receives joint compound; use at exposed panel edges.
c. L-Bead: L-shaped; exposed long leg receives joint compound; use where indicated.
d. Expansion (Control) Joint: Use where indicated.
e. Specialty reveals and trims: Use where indicated.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated on drawings.

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

a. Fry Reglet Corp.
b. Pittcon Industries.

2. Shapes and Profiles: As indicated on drawings.

3. Intersections: Provide factory fabricated intersections.

4. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.

5. Finish: Class II anodic finish unless indicated otherwise on the drawings

2.7 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.
2. Tile Backer Panels: as recommended by the manufacturer

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints**,** rounded or beveled panel edges**,** and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.

    a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

2.8 ACOUSTICAL SEALANT

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Acoustical Sealant for Exposed and Concealed Joints:

    a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
    b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

2.9 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

C. Isolation Strip at Exterior Walls:

1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Polyethylene Vapor Retarder: As specified in Division 07 Section "Building Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.

1. Furnish concrete inserts and other devises indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLING STEEL FRAMING, GENERAL

A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.

B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written

recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."

C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.

1. Isolate ceiling assemblies where they abut or are penetrated by building structure.

D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

3.4 INSTALLING STEEL SUSPENDED CEILING AND SOFFIT FRAMING

A. Suspend ceiling hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
3. Secure flat hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Do not support ceilings directly from permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
5. Do not attach hangers to steel deck tabs.
6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
7. Do not connect or suspend steel framing from ducts, pipes, or conduit.

B. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet measured lengthwise on each member and transversely between parallel members.

C. Sway-brace suspended steel framing with hangers used for support.

D. Wire-tie furring channels to supports**,** as required to comply with requirements for assemblies indicated.

E. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the referenced steel framing and installation standards.

1. Hangers: 48 inches o.c.
2. Furring Channels (Furring Members): 16 inches o.c.

3.5 APPLYING AND FINISHING PANELS, GENERAL

A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.

B. Install interior gypsum board in the following locations:

1. Regular Type: Vertical surfaces, unless otherwise indicated.
2. Type X: As indicated on Drawings and where required for fire-resistance-rated assembly.
3. Ceiling Type: Ceiling surfaces.
4. Moisture- and Mold-Resistant Type: As indicated on Drawings and in restrooms/janitors closets.
5. Abuse-Resistant Type: As indicated on Drawings.

C. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

D. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

E. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

F. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

G. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

H. Attach gypsum panels to framing provided at openings and cutouts.

I. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members using resilient channels, or provide control joints to counteract wood shrinkage.

J. Form control and expansion joints with space between edges of adjoining gypsum panels.

K. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4 to 3/8 inch wide joints to install sealant.

L. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4 to ½ inch wide spaces at these locations, and trim edges with LC-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

M. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical

sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.

N. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.

1. Space screws a maximum of 12 inches o.c. for vertical applications.

3.6 PANEL APPLICATION METHODS

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically, unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

a. Stagger abutting end joints not less than one framing member in alternate courses of board.
b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.

B. Multilayer Application on Ceilings: Apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

C. Multilayer Application on Partitions/Walls: Apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.

D. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.

E. Multilayer Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.7 APPLYING TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.
B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces

3.8 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations identified and approved by Architect for visual effect on the Contract Documents.

C. Aluminum Trim: Install in locations indicated on Drawings. Provide premanufactured sections at all intersections and transitions.

3.9 FINISHING GYPSUM BOARD ASSEMBLIES

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Level of Finish: “5” through-out. Level “3” in service areas.

3.10 FIELD QUALITY CONTROL

A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Architect will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.

1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
2. Before notifying Architect, complete the following in areas to receive gypsum board ceilings:

    a. Installation of 80 percent of lighting fixtures, powered for operation.
    b. Installation, insulation, and leak and pressure testing of water piping systems.
    c. Installation of air-duct systems.
    d. Installation of air devices.
    e. Installation of mechanical system control-air tubing.
    f. Installation of ceiling support framing.

END OF SECTION 092900

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

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 acoustical panels and exposed suspension systems for ceilings.

1.3 DEFINITIONS

A. AC: Articulation Class.

B. CAC: Ceiling Attenuation Class.

C. LR: Light Reflectance coefficient.

D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

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

B. Samples for Initial Selection: For components with factory-applied color finishes.

C. Maintenance Data: For finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
2. Suspension System: Obtain each type through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
b. Identify materials with appropriate markings of applicable testing and inspecting agency.

2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:

a. Smoke-Developed Index: 450 or less.

C. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:

1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

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

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.8 COORDINATION

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

1.9 EXTRA MATERIALS

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

1. Acoustical Ceiling Panels: Full-size panels equal to 5.0 percent of quantity installed.
2. Suspension System Components: Quantity of each exposed component equal to 5.0 percent of quantity installed.
3. Hold-Down Clips: Equal to 5.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

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

B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

C. Antimicrobial Fungicide Treatment: Provide acoustical panels with face and back surfaces coated with antimicrobial treatment consisting of manufacturer's standard formulation with fungicide added to inhibit growth of mold and mildew and showing no mold or mildew growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

A. Provide acoustical panel products, as noted in the finish schedule on drawing A6.03b.

B. Classification/Color: Provide panels complying with ASTM E 1264 for type, form, color and pattern as indicated on the drawings.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity areas are anticipated.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per

ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

a. Type: Postinstalled expansion anchors.
b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- diameter wire.

E. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

F. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch- thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.

G. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

H. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

I. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.

J. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.

2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

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. Armstrong World Industries, Inc.;
2. Chicago Metallic Corporation;
3. Ecophon CertainTeed, Inc.;
4. USG Interiors, Inc.;

2.5 METAL EDGE MOLDINGS AND TRIM

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. Armstrong World Industries, Inc.;
2. Chicago Metallic Corporation;
3. Ecophon CertainTeed, Inc.;
4. USG Interiors, Inc.;

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:

1. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; organic coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.

a. Organic Coating: Thermosetting, primer/topcoat system with a minimum dry film thickness of 0.8 to 1.2 mils.

2.6 ACOUSTICAL SEALANT

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified

in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

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

3.2 PREPARATION

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

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
8. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
9. Do not attach hangers to steel deck tabs.
10. Do not attach hangers to steel roof deck. Attach hangers to structural members.

11. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
12. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange directionally patterned acoustical panels as follows:

    a. As indicated on reflected ceiling plans.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
3. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. For reveal-edged panels on suspension system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.
5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
6. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.
7. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and

touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096500 - RESILIENT FLOORING ACCESSORIES

PART 1 - GENERAL

1.0 RELATED DOCUMENTS

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

1.1 SUMMARY

A. This Section includes the following:

1. Resilient wall base and accessories.
2. Transition Strips

1.2 SUBMITTALS

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

B. Samples for Verification: Full-size tiles of each different color and pattern of resilient floor tile specified, showing the full range of variations expected in these characteristics.
   1. For resilient accessories, manufacturer's standard-size samples, but not less that 12 inches long, of each resilient accessory color and pattern specified.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing resilient products similar to those required for this Project and with a record of successful in-service performance.

B. Source Limitations: Obtain each type, color, and pattern of product specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

C. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Critical Radiant Flux: 0.45 W/sq. cm or greater when tested per ASTM E 648.
2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E 662.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to Project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.

B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90 deg F

C. Move products into spaces where they will be installed at least 48 hours before installation, unless longer conditioning period is recommended in writing by manufacturer.

1.5 PROJECT CONDITIONS

A. Maintain a temperature of not less than 70 deg F or more than 95 deg F in spaces to receive products for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless manufacturer's written recommendations specify longer time periods. After post installation period, maintain a temperature of not less than 55 deg F or more than 95 deg F.

B. Do not install products until they are at the same temperature as the space where they are to be installed.

C. Close spaces to traffic during flooring installation and for time period after installation recommended in writing by manufacturer.

D. Install flooring and accessories after other finishing operations, including painting, have been completed.

E. Do not install flooring over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive, as determined by flooring manufacturer's recommended bond and moisture test.

1.6 EXTRA MATERIALS

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

1. Furnish not less than one box for each 50 boxes or fraction thereof, of each type, color, pattern, class, wearing surface, and size of resilient tile flooring installed.
2. Furnish not less than 10 linear feet for each 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient accessory installed.
3. Furnish not less than 5%, of each type, color, pattern, and size of resilient sheet or interlocking flooring.
4. Deliver extra materials to Owner.

PART 2 - PRODUCTS

2.0 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated in the drawings.

2.1 RESILIENT TILE

A. Vinyl Floor Tile: Products complying with ASTM F 1700 and with requirements specified in the Finish Schedule Key in the drawings.

2.2 RESILIENT ACCESSORIES

A. Rubber Wall Base: Products complying with FS SS-W-40, Type I and with requirements specified in the Finish Schedule.

C. Rubber Accessory Moldings: Products complying with requirements specified in the Finish Schedule.

2.3 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by flooring manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.0 EXAMINATION

A. Examine substrates, areas, and conditions where installation of resilient products will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for resilient product installation and comply with requirements specified.

B. Concrete Sub-floors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by flooring manufacturer.
2. Sub-floor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving resilient flooring.
3. Sub-floors are free of cracks, ridges, depressions, scale, and foreign deposits.

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

3.1 PREPARATION

A. General: Comply with resilient product manufacturer's written installation instructions for preparing substrates indicated to receive resilient products.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

C. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

D. Broom and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 RESILIENT ACCESSORY INSTALLATION

A. General: Install resilient accessories according to manufacturer's written installation instructions. Provide base materials in 120 ft rolls minimum.

B. Apply resilient wall base to walls, columns, pilasters, in toe spaces, and other permanent fixtures in rooms and areas where base is required unless otherwise noted.

1. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
2. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
3. Do not stretch base during installation.
4. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
5. Form field fabricated/job formed corners.

C. Place resilient accessories so they are butted to adjacent materials and bond to substrates with adhesive. Install reducer strips at edges of flooring that would otherwise be exposed.

D. Apply resilient products to stairs as indicated and according to manufacturer's written installation instructions.

3.3 CLEANING AND PROTECTING

A. Perform the following operations immediately after installing resilient products:

1. Remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.
2. Sweep or vacuum floor thoroughly.
3. Do not wash floor until after time period recommended by flooring manufacturer.
4. Damp-mop floor to remove marks and soil.

B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by flooring manufacturer.

1. Apply protective floor polish to floor surfaces that are free from soil, visible adhesive, and surface blemishes, if recommended in writing by manufacturer.

    a. Use commercially available product acceptable to flooring manufacturer.
    b. Coordinate selection of floor polish with Owner's maintenance service.

2. Cover products installed on floor surfaces with undyed, untreated building paper until inspection for Substantial Completion.
3. Do not move heavy and sharp objects directly over floor surfaces. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

C. Clean floor surfaces not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products according to manufacturer's written recommendations.

1. Before cleaning, strip protective floor polish that was applied after completing installation only if required to restore polish finish and if recommended by flooring manufacturer.
2. After cleaning, reapply polish to floor surfaces to restore protective floor finish according to flooring manufacturer's written recommendations. Coordinate with Owner's maintenance program.

END OF SECTION 096500

SECTION 096566 - RESILIENT ATHLETIC FLOORING

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. Rubber floor tile.

B. Related Sections:

1. Section 09650 "Resilient Flooring Accessories" for wall base and accessories installed with flooring.

1.3 SUBMITTALS

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

B. Shop Drawings: Show installation details and locations of the following:

1. Border tiles.
2. Floor patterns.
3. Layout, colors, widths, and dimensions of game lines and markers.
4. Locations of floor inserts for athletic equipment installed through flooring.

C. Samples for Initial Selection: For each type of flooring indicated.

D. Samples for Verification: For each type, color, and pattern of flooring indicated, 6-inch- square Samples of same thickness and material indicated for the Work.

E. Maintenance Data: For flooring to include in maintenance manuals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish no fewer than 1 box for each 50 boxes or fraction thereof, of each type, color, pattern, and size of floor tile installed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storing.

B. Store materials to prevent deterioration. Store tiles on flat surfaces.

1.6 FIELD CONDITIONS

A. Adhesively Applied Products:

1. Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive flooring 48 hours before installation, during installation, and 48 hours after installation unless longer period is recommended in writing by manufacturer.
2. After postinstallation period, maintain temperatures within range recommended in writing by manufacturer, but not less than 55 deg F or more than 95 deg F.
3. Close spaces to traffic during flooring installation.
4. Close spaces to traffic for 48 hours after flooring installation unless manufacturer recommends longer period in writing.

B. Install flooring after other finishing operations, including painting, have been completed.

1.7 COORDINATION

A. Coordinate layout and installation of flooring with floor inserts for gymnasium equipment.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. FloorScore Compliance: Resilient athletic flooring shall comply with requirements of FloorScore Standard.

2.2 RUBBER FLOOR TILE

A. Acceptable manufacturers and products are as follows:

1. Plae, Achieve

B. Material: Engineered EPDM, recycled crumb rubber and urethane binder

C. Tile Interlock: Hidden.

D. Traffic-Surface Texture: Smooth.

E. Size: 24 inches square.

F. Thickness: 1 inch.

G. Color and Pattern: As selected by Architect from manufacturer's full range.

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 of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. 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 flooring.

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 Testing: Perform pH testing according to ASTM F 710. Proceed with installation only if pH readings are not less than 7.0 and not greater than 8.5.
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.

1) Perform tests so that each test area does not exceed <**Insert area**>, and perform no fewer than two tests in each installation area and with test areas evenly spaced in installation areas.

b. Perform relative humidity test using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.

D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

E. Move flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation unless manufacturer recommends a longer period in writing.

1. Do not install flooring until they are same temperature as space where they are to be installed.

F. Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust.

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

3.3 FLOORING INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions.

B. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.

C. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.

D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on flooring. Use nonpermanent, nonstaining marking device.

3.4 FLOOR TILE INSTALLATION

A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis.

B. Discard broken, cracked, chipped, or deformed tiles.

C. Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged if so numbered.

1. Lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern).

D. Free-Lay Flooring: Place flooring at locations indicated with all units securely interconnected and fully seated on substrate to form a smooth, level surface.

3.5 FIELD-APPLIED FINISHES

A. Apply finish according to manufacturer's written instructions to produce a sealed surface that is ready for use.

B. Do not cover flooring after finishing until finish reaches full cure.

3.6 CLEANING AND PROTECTING

A. Perform the following operations immediately after completing flooring installation:

1. Remove adhesive and other blemishes from flooring surfaces.
2. Sweep and vacuum flooring thoroughly.

3. Damp-mop flooring to remove marks and soil after time period recommended in writing by manufacturer.

B. Protect flooring 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.

1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 096566

SECTION 099100 - PAINTING

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 surface preparation and the application of paint systems on the following interior new and existing substrates:

1. Concrete Masonry Units (CMU)
2. Metal Ductwork
3. Metal Conduit
4. Steel
5. Gypsum board
6. Wood Trim
7. Stucco

B. This Section includes surface preparation and the application of paint systems on the following exterior substrates:

1. Galvanized metal
2. Steel
3. CMU
4. Wood trim

C. Related Sections include the following:

1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
2. Division 08 Sections for factory priming windows and doors with primers specified in this Section.

1.3 SUBMITTALS

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

B. Product List: Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."

a. For indoor paints to maintain indoor air quality, use only MPI listed materials having a minimum E2 rating

2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

B. Quantity: Furnish an additional 2 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer Limitations

1. Provide all materials for all systems from the same manufacturer except where the manufacturer does not offer products in a specific system that conform to the requirements.

B. 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. Benjamin Moore & Co.
2. PPG Architectural Finishes, Inc.
3. Sherwin-Williams Company (The) (Basis of Design per sheet A6.03b)

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For existing surfaces, verify the types of existing substrates and provide paint system compatible with surface to be covered (existing paint) while maintaining the intended sheen for the base material of the substrate.
3. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors: As selected from manufacturers full range of colors.

C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
2. Restricted Components: Paints and coatings shall not contain any of the following:

    a. Acrolein.
    b. Acrylonitrile.
    c. Antimony.
    d. Benzene.
    e. Butyl benzyl phthalate.
    f. Cadmium.
    g. Di (2-ethylhexyl) phthalate.
    h. Di-n-butyl phthalate.
    i. Di-n-octyl phthalate.
    j. 1,2-dichlorobenzene.
    k. Diethyl phthalate.
    l. Dimethyl phthalate.
    m. Ethylbenzene.
    n. Formaldehyde.
    o. Hexavalent chromium.
    p. Isophorone.
    q. Lead.
    r. Mercury.
    s. Methyl ethyl ketone.
    t. Methyl isobutyl ketone.
    u. Methylene chloride.
    v. Naphthalene.
    w. Toluene (methylbenzene).

x. 1,1,1-trichloroethane.
y. Vinyl chloride.

2.3 INTERIOR BLOCK FILLERS

A. Interior/Exterior Latex Block Filler: MPI #4.

1. VOC Content: E Range of E3.

2.4 PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: EPR 3.

B. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

C. Interior Waterbase Acrylic Primer

D. Exterior/Interior Waterborne Epoxy Polyamide Primer

E. Exterior Bonding Primer (Water Based): MPI #17.

1. VOC Content: E Range of E3.

2.5 METAL PRIMERS

A. Cementitious Galvanized-Metal Primer: MPI #26.

1. VOC Content: E Range of E1.

B. Alkyd Anticorrosive Metal Primer: MPI #79.

1. VOC Content: E Range of E2.

C. Waterborne Galvanized-Metal Primer: MPI #134.

1. VOC Content: E Range of E2.
2. Environmental Performance Rating: EPR 2.

2.6 WOOD PRIMERS

A. Interior Latex-Based Wood Primer: MPI #39.

1. VOC Content: E Range of E2.
2. Environmental Performance Rating: EPR 2.

2.7 INTERIOR LATEX PAINTS

A. Interior Latex (Eggshell): MPI #52 (Gloss Level 3).

1. VOC Content: E Range of E2.
2. Environmental Performance Rating: EPR 2.

B. Interior Latex (Satin): MPI #43 (Gloss Level 4).

1. VOC Content: E Range of E2.
2. Environmental Performance Rating: EPR 2.5.

C. Interior Latex (Flat): MPI #53 (Gloss Level 1).

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: EPR 2.5.

D. Interior Latex (Semigloss): MPI #54 (Gloss Level 5).

1. VOC Content: E Range of E2.
2. Environmental Performance Rating: EPR 3.

E. High-Performance Architectural Latex (Low Sheen): MPI #138 (Gloss Level 2).

1. VOC Content: E Range of E2.
2. Environmental Performance Rating: EPR 4.

F. High-Performance Architectural Latex (Eggshell): MPI #139 (Gloss Level 3).

1. VOC Content: E Range of E2.
2. Environmental Performance Rating: EPR 5.

G. High-Performance Architectural Latex (Satin): MPI #140 (Gloss Level 4).

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: EPR 6.5.

H. High-Performance Architectural Latex (Semigloss): MPI #141 (Gloss Level 5).

1. VOC Content: E Range of E2.
2. Environmental Performance Rating: EPR 6.

2.8 INTERIOR ALKYD PAINTS

A. Interior Alkyd (Semigloss): MPI #47 (Gloss Level 5).

1. VOC Content: E Range of E2.
2. Environmental Performance Rating: EPR 2.

B. Interior Alkyd (Gloss): MPI #48 (Gloss Level 6).
1. VOC Content: E Range of E1.

2.9 EXTERIOR ALKYD PAINTS

A. Exterior Alkyd Enamel (Gloss): MPI #9 (Gloss Level 6).
1. VOC Content: E Range of E1.

2.10 EXTERIOR ACRYLIC PAINTS

A. Exterior Acrylic Enamel (Semigloss): MPI #107 (Gloss Level 5).
1. VOC Content: E Range of E2.

2.11 EXTERIOR LATEX PAINTS

A. Exterior Latex (Semigloss): MPI #11 (Gloss Level 5).

1. VOC Content: E Range of E3.

2.12 FLOOR COATINGS

A. Interior/Exterior Clear Concrete Floor Sealer (Water Based): MPI #99.

1. VOC Content: E Range of E2.

B. Interior/Exterior Clear Concrete Floor Sealer (Solvent Based): MPI #104.

1. VOC Content: E Range of E2.

C. Exterior/Interior Alkyd Floor Enamel (Gloss): MPI #27 (Gloss Level 6).

1. VOC Content: E Range of E2.
2. Additives: Manufacturer's standard additive to increase skid resistance of painted surface.

2.13 INTERIOR ACRYLIC/URETHANE DISPERSION

A. Interior Acrylic (Eggshell)

2.14 WATERBORNE EPOXY PAINT

A. Interior Epoxy (Semigloss)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMU): 12 percent.
3. Wood: 15 percent.
4. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

H. Aluminum Substrates: Remove surface oxidation.

I. Wood Substrates:
1. Sand surfaces that will be exposed to view, and dust off.
2. Prime edges, ends, faces, undersides, and backsides of wood.
3. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

J. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:

1. Mechanical/Plumbing Work:

a. Uninsulated metal piping.
b. Uninsulated plastic piping.
c. Pipe hangers and supports.
d. Insulated items that have been previously painted.
e. Tanks that do not have factory-applied final finishes.
f. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

h. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

2. Electrical Work:
   a. Electrical equipment that is indicated to have a factory-primed finish for field painting.
   b. Conduits & back/junction boxes
   c. Electrical & low voltage panel tubs

3.4 FIELD QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:

1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. CMU Substrates:

1. High-Performance Architectural Latex System: MPI INT 4.2D.

   a. Prime Coat: Interior/exterior latex block filler.
   b. Intermediate Coat: High-performance architectural latex matching topcoat.
   c. Topcoat: High-performance architectural latex (semi-gloss or eggshell as indicated in the finish schedule).

B. Steel Substrates:

1. Alkyd System: MPI INT 5.1E.

a. Prime Coat: Alkyd anticorrosive metal primer.
b. Intermediate Coat: Interior alkyd matching topcoat.
c. Topcoat: Interior alkyd (semi-gloss).

C. Galvanized Steel Substrates:

1. Alkyd System: MPI INT 5.3C.

a. Prime Coat: Cementitious galvanized-metal primer.
b. Intermediate Coat: Interior alkyd matching topcoat.
c. Topcoat: Interior alkyd (semi-gloss).

D. Gypsum Board Substrates (Walls):

1. High-Performance Architectural Latex System: MPI INT 9.2B.

a. Prime Coat: Interior latex primer/sealer.
b. Intermediate Coat: High-performance architectural latex matching topcoat.
c. Topcoat: High-performance architectural latex (semi-gloss or eggshell as indicated in the finish schedule).

E. Gypsum Board Substrates (Ceilings):

1. High-Performance Architectural Latex System: MPI INT 9.2B.

a. Prime Coat: Interior latex primer/sealer.
b. Intermediate Coat: High-performance architectural latex matching topcoat.
c. Topcoat: High-performance architectural latex (flat).

F. Concrete Substrates, Traffic Surfaces:

1. Alkyd Floor Enamel System: MPI INT 3.2B.

a. Prime Coat: Exterior/interior alkyd floor enamel (gloss).
b. Intermediate Coat: Exterior/interior alkyd floor enamel (gloss).
c. Topcoat: Exterior/interior alkyd floor enamel (gloss).

2. Clear Sealer System: MPI INT 3.2F.

a. First Coat: Interior/exterior clear concrete floor sealer (solvent based).
b. Topcoat: Interior/exterior clear concrete floor sealer (solvent based).

3. Water-Based Clear Sealer System: MPI INT 3.2G.

a. First Coat: Interior/exterior clear concrete floor sealer (water based).
b. Topcoat: Interior/exterior clear concrete floor sealer (water based).

3.7 EXTERIOR PAINTING SCHEDULE

A. Galvanized-Metal Substrates:

1. Alkyd System: MPI EXT 5.3B.

   a. Prime Coat: Cementitious galvanized-metal primer.
   b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
   c. Topcoat: Exterior alkyd enamel (gloss).

2. Latex semi-gloss finish system MPI EXT 5.3H

   a. Waterborne galvanized-metal primer.
   b. Intermediate Coat: S-W DTM Acrylic semi-gloss coating matching topcoat, B66-200 Series.
   c. Topcoat: S-W DTM Acrylic semi-gloss coating, B66-200 Series (2-4 mils dry per coat).

END OF SECTION 099100

SECTION 104400 - FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fire protection cabinets for portable fire extinguishers.
2. Portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.3 SUBMITTALS

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

1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets

B. Fire Extinguishers: For each type of product.

1. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
2. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.

C. Maintenance Data: For fire extinguisher cabinets to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

1.5 COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire protection cabinets with wall depths.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 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. Fire-Protection Cabinets:
1. J.L. Industries, Inc.
2. Larsen's Manufacturing Company.
3. Modern Metal Products; Div. of Technico.
4. Samson Products, Inc.
5. Thomas Enterprises.

B. Fire Extinguishers:

1. Badger Fire Protection.
2. Buckeye Fire Equipment Company.
3. Guardian Fire Equipment, Inc.
4. JL Industries, Inc.; a division of the Activar Construction Products Group.
5. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
6. Larsens Manufacturing Company.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

B. Stainless-Steel Sheet: ASTM A 666, Type 304.

C. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 FIRE PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

B. Cabinet Construction: Nonrated.

C. Cabinet Material: Material to match existing cabinets

1. Shelf: Same metal and finish as cabinet.

D. Recessed or Semirecessed Cabinet to match existing: Cabinet box partially/fully recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.

1. Rolled-Edge Trim: match existing, where none exist, use 2-1/2-inch backbend depth.

E. Cabinet Trim Material: Same material and finish as door.

F. Door Material: Match existing

G. Door Style: Match existing

H. Door Glazing: Tempered float glass (clear).

I. Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide concealed door pull and friction latch. Provide concealed-type hinge permitting door to open 180 degrees.

J. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.

a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."

1) Location: Applied to cabinet door.
2) Application Process: Engraved.
3) Lettering Color: Match existing
4) Orientation: match existing

K. Finishes:

1. Match existing

2.4 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

1. Valves: Manufacturer's standard.
2. Handles and Levers: Manufacturer's standard.
3. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

B. Multipurpose Dry-Chemical Type in Steel or aluminum Container: UL-rated 2-A:10-B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.5 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

2.6 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.7 FABRICATION

A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.
3. Prepare doors and frames to receive locks.
4. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.8 GENERAL FINISH REQUIREMENTS

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

B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 STEEL FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling".

B. Factory Prime Finish: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

C. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

1. Color and Gloss: As selected by Architect from manufacturer's full range to match existing cabinets.

2.10 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.
3. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.

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

3.2 PREPARATION

A. Prepare recesses for semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.

B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire protection cabinets.
2. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.

C. Identification: Apply decals or vinyl lettering at locations indicated.

D. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.

E. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 122413 - ROLLER WINDOW SHADES

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. Manually operated roller shades with single rollers.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

C. Samples: For each exposed product and for each color and texture specified, 10 inches long.

D. Samples for Initial Selection: For each type and color of shadeband material.

1. Include Samples of accessories involving color selection.

E. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 10 inches square. Mark inside face of material if applicable.
2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
3. Installation Accessories: Full-size unit, not less than 10 inches long.

F. Roller-Shade Schedule: Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of shadeband material, signed by product manufacturer.

C. Product Test Reports: For each type of shadeband material, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roller shades to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

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

1. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than one unit.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Draper Inc.
2. Hunter Douglas Contract.
3. MechoShade Systems, Inc.

B. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Manufacturer's standard.

a. Loop Length: Full length of roller shade.
b. Limit Stops: Provide upper and lower ball stops.
c. Chain-Retainer Type: Clip, jamb mount.

2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller-shade weight and lifting heavy roller shades.

a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criteria are more stringent.

B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of inside face of shade.
2. Direction of Shadeband Roll: Regular, from back of roller.
3. Shadeband-to-Roller Attachment: Manufacturer's standard method.

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

E. Shadebands:

1. Shadeband Material: Light-filtering fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material.

b. Color and Finish: As selected by Architect from manufacturer's full range.

F. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

   a. Shape: L-shaped.
   b. Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 3 inches.

2. Endcap Covers: To cover exposed endcaps.
3. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

1. Source: Roller-shade manufacturer.
2. Type: Woven polyester and PVC-coated polyester.
3. Weave: Mesh.
4. Openness Factor: 10 percent.
5. Color: As selected by Architect from manufacturer's full range.

2.4 ROLLER-SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances,and other conditions affecting performance of the Work.

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

3.2 ROLLER-SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 122413

SECTION 123216 - MANUFACTURED PLASTIC-LAMINATE-FACED CASEWORK

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 plastic-laminate-faced cabinets of stock design.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood blocking for anchoring casework.
2. Section 096513 "Resilient Base and Accessories" for resilient base applied to plastic-laminate-faced casework.

1.3 DEFINITIONS

A. Definitions in the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" apply to the work of this Section.

B. MDF: Medium-density fiberboard.

C. Hardwood Plywood: A panel product composed of layers or plies of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or particleboard core, joined with adhesive, and faced both front and back with hardwood veneers.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that casework can be supported and installed as indicated.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show fabrication details, including types and locations of hardware. Show installation details, including field joints and filler panels. Indicate manufacturer's catalog numbers for casework.

C. Keying Schedule: Include schematic keying diagram and index each key set to unique designations that are coordinated with the Contract Documents.

D. Samples for Initial Selection: For cabinet finishes.

E. Samples for Verification: 8-by-10-inch Samples for each type of finish.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.

B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install casework until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period. Maintain temperature and relative humidity during the remainder of the construction period in range recommended for Project location by the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."

B. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

C. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed, and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of casework that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Delamination of components or other failures of glue bond.

b. Warping of components.
c. Failure of operating hardware.

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain plastic-laminate-faced cabinets from single manufacturer.

2.2 CASEWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" for grades of casework indicated for construction, finishes, installation, and other requirements.

1. Grade: Custom.

2.3 CASEWORK

A. Design:

1. Flush overlay.

B. Exposed Materials:

1. Plastic Laminate: Grade HGS.

a. Colors and Patterns: As selected by Architect from manufacturer's full range.

2. Unless otherwise indicated, provide specified edgebanding on all exposed edges.

C. Semiexposed Materials:

1. Thermoset Decorative Panels: Provide thermoset decorative panels for semiexposed surfaces unless otherwise indicated.

a. Provide plastic laminate of same grade as exposed surfaces for interior faces of doors and drawer fronts and other locations where opposite side of component is exposed.

2. Hardboard: Use only for cabinet backs where exterior side of back is not exposed.
3. Unless otherwise indicated, provide specified edgebanding on all semiexposed edges.

D. Concealed Materials:

1. Solid Wood: Any hardwood or softwood species, with no defects affecting strength or utility.
2. Plywood: Hardwood plywood.

3. Plastic Laminate: Grade BKL.
4. Particleboard.
5. MDF.
6. Hardboard.

2.4 MATERIALS

A. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.

B. Hardwood Plywood: HPVA HP-1, particleboard core except where veneer core is indicated.

C. Softwood Plywood: DOC PS 1.

D. Particleboard: ANSI A208.1, Grade M-2.

E. MDF: ANSI A208.2, Grade 130.

F. Hardboard: ANSI A135.4, Class 1 Tempered.

G. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.

1. Colors as indicated on drawings, or if not indicated, as selected by Architect from manufacturer’s full range of laminates.

H. Edgebanding for Plastic Laminate: Plastic laminate matching adjacent surfaces.

I. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

J. Edgebanding for Thermoset Decorative Panels: PVC or polyester edgebanding matching thermoset decorative panels.

2.5 COLORS AND FINISHES

A. Thermoset Decorative Panel Colors, Patterns, and Finishes: As indicated by manufacturer's designations.

B. Plastic-Laminate Colors, Patterns, and Finishes: As indicated by manufacturer's designations.

C. PVC Edgebanding Color: As selected from casework manufacturer's full range.

2.6 FABRICATION

A. Plastic-Laminate-Faced Cabinet Construction: As required by referenced quality standard, but not less than the following:

1. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch veneer core hardwood plywood.
2. Shelves: 3/4-inch-veneer core hardwood plywood.

3. Backs of Cabinets: 1/2-inch-thick particleboard or MDF where exposed, 1/4-inch veneer-core hardwood plywood dadoed into sides, bottoms, and tops where not exposed.
4. Drawer Fronts: 3/4-inch veneer core hardwood plywood.
5. Drawer Sides and Backs: 1/2-inch solid-wood or veneer-core hardwood plywood, with glued dovetail or multiple-dowel joints.
6. Drawer Bottoms: 1/4-inch hardwood plywood glued and dadoed into front, back, and sides of drawers. Use 1/2-inch material for drawers more than 24 inches wide.
7. Doors 48 Inches High or Less: 3/4 inch thick, with particleboard or MDF cores and solid-wood stiles and rails.
8. Doors More Than 48 Inches High: 1-1/16 inches thick, with honeycomb cores and solid hardwood stiles and rails.
9. Doors More Than 48 Inches High: 1-1/8 inches thick, with particleboard cores.

B. Filler Strips: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.

2.7 CASEWORK HARDWARE AND ACCESSORIES

A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard satin-finish, commercial-quality, heavy-duty hardware.

1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.

B. Frameless Concealed Hinges (European Type): BHMA A156.9, Type B01602, 135 degrees of opening. Provide two hinges for doors less than 48 inches high, and provide three hinges for doors more than 48 inches high.

C. Pulls: Solid plated brass wire pulls, fastened from back with two screws. . Provide two pulls for drawers more than 24 inches wide.

D. Door Catches: Powder-coated, nylon-roller spring catch. Provide two catches on doors more than 48 inches high.

E. Drawer Slides: BHMA A156.9, Type B05091.

1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated, steel ball-bearing slides.
2. Box Drawer Slides: Grade 1HD-100, for drawers not more than 6 inches high and 24 inches wide.
3. File Drawer Slides: Grade 1HD-200, for drawers more than 6 inches high or 24 inches wide.

F. Label Holders: Stainless steel or chrome plated, sized to receive standard label cards approximately 1 by 2 inches, attached with screws or brads.

1. Provide label holders where indicated.

G. Adjustable Shelf Supports: Mortise-type, zinc-plated steel standards and shelf rests complying with BHMA A156.9, Types B04071 and B04091.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of the Work.

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

3.2 CASEWORK INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Install casework level, plumb, and true; shim as required, using concealed shims. Where casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

C. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch of a single plane. Align similar adjoining doors and drawers to a tolerance of 1/16 inch. Bolt adjacent cabinets together with joints flush, tight, and uniform.

D. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten to hanging strips, masonry, framing, wood blocking, or reinforcements in walls and partitions. Align similar adjoining doors to a tolerance of 1/16 inch.

E. Fasten cabinets to adjacent cabinets and to masonry, framing, wood blocking, or reinforcements in walls and partitions to comply with the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."

F. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.

G. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.3 CLEANING

A. Repair or remove and replace defective work as directed on completion of installation.

B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

END OF SECTION 123216

SECTION 123616 - METAL COUNTERTOPS

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. Stainless steel clad countertops

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver metal countertops only after casework has been completed in installation areas.

B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of construction to receive metal countertops by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Zinc alloy

B. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

C. Sealant for Countertops: Manufacturer's standard sealant of characteristics indicated below that complies with applicable requirements in Section 079200 "Joint Sealants."

1. Mildew-Resistant Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, silicone.
2. Color: Clear.

2.2 STAINLESS STEEL CLAD COUNTERTOPS

A. Backing Material: Fabricate backing of countertop including backsplashes and front edges from exterior grade plywood as indicated on the drawings and recommended by the manufacturer. Fill and smooth all joints to prevent telegraphing of substrate through stainless cladding.

B. Countertops: 16 Ga Stainless steel sheet.

1. Joints: Fabricate countertops without field-made joints where possible, minimize joints.
2. Weld all corners and joints. Miter counters in corner conditions.
3. Factory punch holes for fittings and sinks.

C. Adhesives: As recommended by the stainless steel countertop manufacturer for adhering stainless steel cladding to backing

D. Finish: Clean and buff surfaces to produce uniform finish, free of cross scratches. Run grain with long dimension of each piece. Remove embedded foreign matter and leave surfaces clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of metal countertops.

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

3.2 INSTALLATION

A. Install metal countertops level, plumb, and true; shim as required, using concealed shims.

B. Field Jointing: Where possible, make field jointing in the same manner as shop jointing; use fasteners and methods recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

C. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.

D. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

E. Wall-Mounted Shelves: Fasten to masonry, partition framing, blocking, or reinforcements in partitions. Fasten each shelf through upturned back edge at not less than 24 inches o.c.

3.3 FINISHING, CLEANING AND PROTECTION

A. Repair or remove and replace defective work as directed on completion of installation.

B. Buff exposed surfaces with orbital sander and maximum 220 grit wet/dry sandpaper to an even finish. Do not use chemicals or cleaners.

C. Apply Cupric Sulfate to patina zinc in pattern as selected by Architect. Provide zinc patterning option samples and zinc sheet for mockup and testing of patterns.

D. Seal zinc counters with clear spray lacquer sealer in a minimum of 3 light coats.

E. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

F. Protection: Provide 6-mil plastic or other suitable water-resistant covering over the countertop surfaces. Tape to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION 123616

SECTION 21 00 00 – FIRE SUPPRESSION WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes a summary of all Fire Suppression related work.

B. Related Sections:

1. 21 05 00 – COMMON WORK RESULTS FOR FIRE SUPPRESSION
2. 21 05 23 – GENERAL-DUTY VALVES FOR FIRE SUPPRESSION SYSTEMS
3. 21 05 29 – HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEMS
4. 21 05 53 – IDENTIFICATION FOR FIRE SUPPRESSION SYSTEMS
5. 21 13 13 – WET-PIPE SPRINKLER SYSTEMS

C. Work by Others:

1. The following work will be done by other contractors, as specified under respective headings, which this contractor shall read to ascertain what is called for therein:
   a. General Construction
   b. Plumbing
   c. HVAC
   d. Integrated Automation
   e. Electric
   f. Technology

1.3 PROJECT CONDITIONS

A. Alterations of and Additions to Fire Suppression Systems

1. The contract shall include new work as shown, specified, or required, and shall include, but not limited to, the following principal components:
   a. Provide wet pipe sprinkler system in new building addition, as designated on the drawings. All sprinkler heads shall be extended coverage type.
   b. Provide requisite drain piping.
   c. Perform start-up for all fire suppression systems and commission same in accordance with the commissioning requirement.
   d. Provide and/or participate in training of Owner's personnel on the use of all new fire suppression systems.
2. All work shall be performed in strict accordance with the City of Oxford and State of Ohio rules, regulations, and drawings.

3. The contractor shall exercise adequate protective and safety measures for all persons and property and shall be responsible for any damages or injuries arising from the execution of this work.
4. Alterations of and additions to existing systems shall include the requisite rigging, wrecking, hauling, protection of permanent equipment and the building structures, and cleaning up. Care shall be exercised to keep dust and dirt to a minimum. All debris shall be promptly removed.
5. The existing facility will be occupied and will remain in operation throughout the period that this work is being performed, and certain new work will be performed during this period. Unscheduled interruptions of the facility will not be tolerated. The contractor shall exercise extreme caution, shall thoroughly inform his workmen and subcontractors of the critical nature of this work, and shall continually review the work procedure being followed in order to prevent accidental interruption of service. Before performing any act which could result in interruption of service, the contractor shall notify the Owner and Engineer of the hazards involved and the contractor shall proceed in a manner and at a time specifically approved by the Owner and Engineer.
6. All work necessitating the temporary turning off or shutting down the operation of existing mechanical and/or electrical facilities shall be done at times specifically approved by the Owner and Engineer in advance of any disruption of existing facilities. Also, refer to Section 21 04 00 – General Fire Suppression System Requirements.

B. Installation of Pipe:

1. Codes:
   a. All work, including joints, fittings, hangers, slope of piping, drains, etc. shall be installed in strict accordance with applicable City, County, and State laws and codes, and NFPA bulletins including latest revisions. All material and equipment shall bear U. L. label or similar acceptable identification.

C. Drains:

1. Provide 1” test valves and/or drain valves where required by code or at all low points in piping in all systems and extend drain piping to exterior of building, nearest floor drain, or janitor’s receptor as approved by Engineer.

D. Design of Systems:

1. Sprinkler Contractor shall lay out sprinkler heads and design piping distribution systems using the hydraulic calculation method based on NFPA Bulletin 13, unless specified otherwise. Refer to Section 21 13 13 for Hazard Classifications.
2. For compiling their bids, contractors shall layout and design a system using the hydraulic calculation method based on the sprinkler head location for the above coverage requirements and F.M. requirements. The successful low bidder shall submit his plans and calculations for approval to the Engineer and then to appropriate agencies and authorities for approval and permits.

E. Flow Test:

1. All calculations shall include flow test results. Flow tests shall be performed by the successful Fire Protection Contractor and verified by the local fire department, and/or Engineer. Prior flow tests on file with jurisdictional agencies may be used in lieu of new flow tests only when previous test has been made within 3 months of project start date.
2. Contractor shall use 90% of flow test pressure data as the base in performance of the small calculations and the system shall be calculated from the flow test evaluation to the highest sprinkler head.

F. Shop Drawings:

1. As soon as possible after award of the contract, and prior to fabrication, the contractor shall prepare complete shop drawings of the sprinkler systems, which shall in general conform to the bidding documents; any deviations deemed necessary by the contractor shall be noted and agreed upon prior to starting the work.
2. In preparing his working drawings, the contractor shall coordinate the location of sprinkler heads and piping with the other contractors and with existing conditions. Drawings shall show ceiling grids, lights, registers, grilles, heat detection devices, access panel, skylights, audio/visual devices and equipment, etc. Any changes in fabricated sprinkler piping occasioned by lack of coordination shall be made by the contractor at no change in the contract price.
3. All drawings and calculations shall be reviewed and accepted by the Engineer before submitting them to the local fire department, building department, state, fire marshal, and the insurance carrier or insurance reviewing authority. Indication of review and/or acceptance by the agencies shall be certified by name of the reviewer, agency, and date affixed to the plans or reproducibles submitted.

G. Fees

1. Contractors shall pay all charges and fees pertaining to plan reviews, permits, inspections, etc.

H. Performance:

1. Fire protection work shall be performed by a Sprinkler Contractor certified for sprinkler work by State Fire Marshal.
2. Wiring for tamper switches, alarms, etc. shall be furnished and installed by Electric Contractor.

I. Excavation And Backfilling And Restoration Of Surfaces

1. Refer to Division 01 and Section 21 04 00.

J. Guarantee

1. This contractor shall guarantee all workmanship, materials, and equipment entering into this contract for a period of one year; all from date of substantial completion or from the "recognized" start-up date, whichever is later. Should the Owner elect to accept a portion of work prior to the date of substantial completion, the guarantee period for the accepted portion of the work shall commence on the date of acceptance or on the "recognized" start-up date for that portion of the work, whichever is later. If the specifications dictate a different period of guarantee for a given component or piece of equipment, the more stringent requirements shall govern.
2. The "recognized" start-up date shall be defined as that date on which the contractor has successfully completed all work, including the following:
   a. Submitted and received approval of four (4) copies of the Instruction Booklets.
   b. Submitted complete "As-Built" drawings.
   c. Completed all testing, cleaning, adjusting, and trial run.
3. In the case where the Engineer is accepting a portion of the work, the contractor shall have completed all phases of that portion of the work to be accepted, including Items above, for that accepted portion of the work.
4. Any workmanship, materials, or equipment proving to be defective during this guarantee period shall be made good by this contractor without additional cost to the Owner.
5. Refer to Division 00.

K. Equipment

1. Any and all costs associated with piping, electric, wiring, conduit, supports, pads, or other modifications to accommodate installation for manufacturer's equipment that differs from equipment layout on drawings shall be included on contractor's bid. The contractor is responsible to insure that the equipment will fit within space allocated with appropriate clearances for maintenance, operation, servicing, and code.

L. Schedule

1. The contractor shall be responsible to meet the project schedule as stated by the Owner. The contractor shall include in his bid the cost associated with all requisite coordination.
2. In addition, the contractor must prepare a schedule for his work that integrates with the Owner's schedule. The contractor shall update progress and revise schedule at least twice monthly.
3. This contractor shall be responsible to expedite any materials and work any overtime in order to meet the schedule. The cost for any expediting of overtime work shall be included in his bid.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 21 00 00

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SECTION 21 05 00 – COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Mechanical sleeve seals.
3. Sleeves.
4. Escutcheons.
5. Grout.
6. Fire-suppression equipment.
7. Equipment installation requirements common to equipment sections.
8. Painting and finishing.
9. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, 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 chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.

2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Mechanical sleeve seals.
2. Escutcheons.

1.5 QUALITY ASSURANCE

A. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression 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 fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

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

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 21 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.

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.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: 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. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

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, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

D. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

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 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    e. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw.
    f. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
    g. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. 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.

    a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
    b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.

c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

1) Seal space outside of sleeve fittings with grout.
2) Except for underground wall penetrations, seal annular space between sleeve and pipe, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21 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. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PAINTING

A. Painting, if any, of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.5 GROUTING

A. Clean surfaces that will come into contact with grout.

B. Provide forms as required for placement of grout.

C. Avoid air entrapment during placement of grout.

D. Place grout, completely filling equipment bases.

E. Place grout on concrete bases and provide smooth bearing surface for equipment.

F. Place grout around anchors.

G. Cure placed grout.

END OF SECTION 21 05 00

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SECTION 21 05 23 – GENERAL-DUTY VALVES FOR FIRE SUPPRESSION 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. Underwater laboratory approved valves.
   2. Water service valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:
1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

B. Valve Sizes: Same as upstream piping unless otherwise indicated.

C. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

D. Valve Bypass and Drain Connections: MSS SP-45.

E. Furnish and install all valves where shown or required for the proper operation of the system.

F. Valves shall always be placed in accessible positions for operation and repairs.

G. Provide chain operators on all valves 3" and larger installed more than 7'-0" above mechanical equipment and floors.

2.2 UNDERWRITER LABORATORY APPROVED VALVES

A. Butterfly Valves 2-1/2" and larger shall be Grinnell Series 8000 FP, Central, Mueller, Stockham, or equal, UL approved lug type butterfly valves with handwheel and factory pre-adjusted internal monitor switch (GS-1).

B. Butterfly Valves 2" and smaller shall be Milwaukee Valve Co. Model BB501, Central, or Nibco, 175 lb. with built-in tamper switch with S.P.D.T. micro switch.

C. Gate Valves OS & Y 2-1/2" and larger shall be Mueller Fig. A-2078-6, Central, Stockham, or Nibco, outside screw and yoke type, cast iron, epoxy coated body, resilient wedge, UL approved for 200 psi working pressure (400 psi test).

D. Gate Valves 2" and smaller shall be Grinnell Fig. 2920, Central, Stockham, or approved equal, UL approved all bronze, 175 lb. working pressure (300 lb. test).

E. Globe Valves shall be Grinnell Fig. 97-SD, Central, Stockham, or approved equal, UL approved all bronze 175 lb. W.O.G. (300 lb. test).

F. Check Valves 4" and larger shall be Grinnell-Kennedy Fig. 126, Central, Stockham, or approved equal, UL approved swing check, bronze and steel, 175 lb. working pressure (300 lb. test).

G. Check Valves 3" and smaller shall be Grinnell-Kennedy Fig. 2950, Central, Stockham, or approved equal, UL approved swing check, all bronze, 175 lb. W.O.G. (300 lb. test).

H. Angle Valves shall be Grinnell Fig. 2930, FP, Central, Stockham, or approved equal, UL approved all bronze, 175 W.O.G. (300 lb. test).

I. Detector Check Valve shall be ITT Grinnel-Hersey, EDC IV, Ames, or approved equal, UL approved, with flanged ends and 1" metered bypass.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. 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.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Locate valves for easy access and provide separate support where necessary.

B. Install valves in horizontal piping with stem at or above center of pipe.

C. Install valves in position to allow full stem movement.

3.3 ADJUSTING

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

END OF SECTION 21 05 23

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SECTION 21 05 29 – HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:
   1. Metal pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Fastener systems.
   5. Pipe stands.
   6. Pipe positioning systems.

B. Related Sections:
   1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for fire suppression piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI7.
   1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
1. Trapeze pipe hangers.
2. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.

PART 2 - PRODUCTS

2.1 HANGERS AND SUPPORTS

A. Horizontal piping 4" and smaller shall be supported by steel clevis or split ring malleable iron hangers with adjustable rods.

B. For all other piping: hangers for pipe sizes 4” and smaller pipe shall be spaced not more than 10-0” apart; provide one additional hanger at each location where pipe changes direction.

C. Hangers for fire protection piping shall be steel hangers complying with the requirements of NFPA bulletins.

D. Hangers for suspended piping shall be Grinnell, Fee and Mason or Gateway hangers each to the following Grinnell Figure Numbers. Hangers shall be Grinnell Fig. 108 split malleable iron pipe ring and Fig. 114 turnbuckle, for pipes 2" and smaller; and Grinnell Fig. 260, steel clevis for 2-1/2" to 4" pipe. Adjustment shall be 2" for securing proper grade and alignment.

E. Pipe supported on floor shall be supported on Grinnell Fig. 259, Fee and Mason, or Gateway pipe consisting of cast iron yoke and nuts. Install on 3" Schedule 40 pipe with steel base plate.

F. Pipe supported on steel support racks shall be supported on Grinnell Fig. 271, Fee and Mason, or Gateway pipe roll stands consisting of cast iron pipe roll, steel rod and cast iron stand.

G. Supports for hangers shall be solid rods of ASTM A-107 steel with running threads on both end rods or shall be all-thread rods. Rods shall be sized according to the requirements of NFPA bulletins and shall be not less than the following:

	SINGLE ROD	TWO RODS
3/4" to 2" Pipe	3/8" Dia.	
2-1/2" to 3" Pipe	2" Dia.	
4" Pipe	5/8" Dia.	1/2" Dia.

H. All rods shall be adjustable and shall be accurately plumbed and double nutted.

I. Piping shall not be supported from ceiling grid, ductwork, electric conduit, heating or fire suppression lines, or any other utility lines, and vice versa. Each utility and the ceiling grid system shall be a separate installation and each shall be independently supported from the building structure. Where interferences occur, in order to support ductwork, piping, conduit, ceiling grid systems, etc., trapeze type hangers or supports shall be employed and shall not be located where they interfere with access to mixing boxes, fire dampers, valves, etc.

J. Hangers under new concrete construction shall be supported by concrete inserts, Grinnell Fig. 282, Fee and Mason or Gateway, malleable iron body and nut. Where additional supports are required, install, per manufacturer's installation instructions and load ratings (with 5:1 safety factor) Rawl or Hilti expansion bolts.

K. Adjacent to concrete and block construction, hangers shall be supported by Rawl or Hilti expansion bolts installed per manufacturer's installation instructions and load ratings (with 5:1 safety factor).

L. Under steel beam construction, hangers shall be supported by beam clamps, Grinnell Fig. 218, Fee and Mason, or Gateway malleable iron jaws with steel rod and nut. Where intermediate support between beams is required, contractor shall weld angle iron supports between beam or joists, top of angles being level with top of building steel.

M. Under bar joist construction, hangers shall be supported by beam clamps, Grinnell Fig. 218, Fee and Mason, or Gateway malleable iron jaws with steel rod and nut. Where intermediate support between beams is required, contractor shall weld angle iron supports between beam or bar joists, top of angles being level with top of building steel.

N. Any cutting and patching required to install hangers, supports, rods, or inserts shall be performed by this contractor.

2.2 SUPPORTS – VERTICAL PIPING

A. Supports - vertical piping shall be supported at intermediate floors with Grinnell Fig. 261, Fee and Mason, or Gateway steel riser clamps placed under hub, fitting, or coupling, and with approved solid bearing on floor construction.

2.3 ANCHORS AND GUIDES

A. Anchors and guides shall be heavy substantial steel anchors of type suitable for the conditions at each location, and place on the pipe lines where shown or necessary to force the expansion in the proper direction. Horizontal anchors shall be constructed of structural angles or shapes properly fabricated and securely bolted to the construction and fitted with clamps and welds to secure the piping. Guides, independent of the expansion joints, shall be installed on pipe lines on each side of joint completely in accordance with manufacturer's recommendations but not less than one guide at 4 pipe diameters and another guide at 14 pipe diameters from each joint to prevent buckling of piping. Certain guides for piping 4" through 6" size, where indicated, shall be Grinnell No. 255.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

J. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

L. Insulated Piping: Comply with the following:
   1. Attach clamps and spacers to piping.

a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

3.2 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.3 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.4 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

3.5 PIPE HOLES

A. Where new piping is to be installed through existing concrete floors or roof, and where holes do not exist, this contractor shall bore new holes and shall protect the building from moisture and/or dust at these locations. Space between bare pipe or insulation and hole shall be caulked so as

to make airtight, waterproof, and with fire resistive rating equal to or greater than the construction penetrated.

B. In fire rated walls, space between bare pipe or insulation and hole shall be filled with the following applicable 3M Brand fire barrier products: Model CP25N/S no-sag caulk, moldable putty, Model FS-195 wrap/strip or Model CS-195 composite sheet.

C. Contractor shall cut and patch all openings in concrete or masonry walls, furnish and set sleeves hereinafter specified, and patch around same.

D. The contractor will close all openings resulting from the removal of piping. Patching work shall match and be integral with existing surrounding surfaces.

3.6 PIPE SLEEVES

A. Where new pipe passes through concrete or masonry walls, inside partitions, or furrings, pipe sleeves ½" larger in diameter than the outside of pipe or pipe covering for which they are intended shall be provided and set in place by this contractor. Contractor shall do all cutting and patching of construction required for the proper installation of the sleeves.

B. No sleeves shall be installed through structural beams or concrete joists unless specifically shown and/or approved.

C. Sleeves through exterior walls below grade shall be Schedule 40 cast iron pipe; all other sleeves shall be Schedule 40 steel pipe. All sleeves shall be machine cut. Space between bare pipe or insulation and sleeves shall be caulked so as to make airtight and waterproof and with fire resistive rating equal to or greater than the construction penetrated. In outside walls, space between sleeve and pipe shall be filled with resilient compressible packing with outside face of joint sealed with permanently flexible caulking material.

D. Wall sleeves shall finish flush with wall lines, and where lateral movement of pipe must be provided for, the sleeves shall be oval in section. Floor sleeves shall be set with bottom flush with finished construction below and top extending 1" above finished floor in wet areas and 1/4" above finished floor in all other areas.

E. For pipe penetrations in exterior building wall, provide mechanical sleeve seals of modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates. Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1" (25 mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals. Install steel pipe for sleeves smaller than 6" (150 mm) in diameter. Install cast-iron “wall pipes” for sleeves 6" (150 mm) in diameter and larger. Assemble and install mechanical sleeve seals according to manufacturer’s written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal. Mechanical sleeve seals shall be manufactured by Calpico, Inc., Metraflex Co., or Thunderline/Link-Seal.

END OF SECTION 21 05 29

SECTION 21 05 53 – IDENTIFICATION FOR FIRE SUPPRESSION 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. Pipe labels.
   2. Stencils.
   3. Valve 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 to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 TAGGING

A. All new valves shall be identified with numbered 2" diameter brass tags attached to valve wheels or stems with heavy brass chains. Tags shall have stamped letters, to designate piping system, and numbers, i.e., - ST-1-1, etc.

B. The contractor shall prepare a printed chart, designating the location and briefly stating the function of each valve so marked, properly classified and placed in numerical order. Copy of chart shall be submitted to the Engineer for proofreading and approval. Approved copy of chart and instructions to be mounted and set in frame under glass and hung in fire pump room. Bind a copy with each set of instructions to be furnished under the General Conditions.

2.2 IDENTIFICATION

A. The contractors shall include identification of all piping installed under their respective contracts. Such identification shall be in the form of stenciling.

B. Contents of piping shall be identified within 3 feet of each valve, or near each branch. All other piping shall be identified along pipe runs at not more than 25 foot intervals where piping is concealed and 50 foot intervals where piping is exposed.

C. Identification of all pipe shall be made in the form of stenciling by applying one heavy coat of enamel and shall consist of identifying name in lettering at least 1" high, 8" long directional arrow below name, and a 2-1/4" wide band consisting of three 3/4" wide bands of different painted colors encircling pipe on each side of name and arrow. In addition, for insulated piping, identifying name shall also identify insulation type. Name, arrow, and bands for the same piping system contents shall be of same colors; colors to be used for various systems shall be as directed by the Engineer.

D. Piping contents shall be labeled as follows:
   1. Wet Sprinkler – Fire Protection - - - - SPRINKLERS

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

END OF SECTION 21 05 53

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SECTION 21 13 13 – WET-PIPE SPRINKLER 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 DESCRIPTION OF WORK

A. Furnish and install automatic wet pipe sprinkler systems for the building addition.

B. Furnish and install the following:

1. Sprinkler zone main shut-off valves.
2. Zone flow alarms and test valves.
3. Sprinkler heads.
4. Mains, branches, drains, and related piping.

1.3 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinklers.
5. Alarm devices.
6. Pressure gages.

B. Related Sections:

1. Division 21 Section "Fire-Suppression Standpipes" for standpipe piping.
2. Division 21 Section "Dry-Pipe Sprinkler Systems" for dry-pipe sprinkler piping.
3. Division 21 Section "Electric-Drive, Centrifugal Fire Pumps" for fire pumps, pressure-maintenance pumps, and fire-pump controllers.

1.4 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.5 SYSTEM DESCRIPTIONS

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

1.6 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications:

    a. Building Service Areas: Ordinary Hazard, Group 1.
    b. Classrooms: Light Hazard.
    c. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
    d. General Storage Areas: Ordinary Hazard, Group 1.
    e. Libraries except Stack Areas: Light Hazard.
    f. Library Stack Areas: Ordinary Hazard, Group 2.
    g. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
    h. Office and Public Areas: Light Hazard.

3. Minimum Density for Automatic-Sprinkler Piping Design:

    a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
    b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
    c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.

4. Maximum Protection Area per Sprinkler: Per UL listing.
5. Maximum Protection Area per Sprinkler:

    a. Office Spaces: 225 sq. ft. (20.9 sq. m).
    b. Storage Areas: 130 sq. ft**.**
    c. Mechanical Equipment Rooms: 130 sq. ft.
    d. Electrical Equipment Rooms: 130 sq. ft.
    e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:

    a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
    b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

C. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.7 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Domestic water piping.
2. HVAC hydronic piping and ductwork.
3. Items penetrating finished ceiling include the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Fire alarm devices.
d. Technology Equipment (i.e. projectors-ceiling mounted; screens, etc).

D. Qualification Data: For qualified Installer.

E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

F. Fire-hydrant flow test report.

G. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

H. Field quality-control reports.

I. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.9 COORDINATION

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

1.10 EXTRA MATERIALS

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

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of three spare sprinklers of each type plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes. Also, refer to Section 211000 for specific piping information.

2.2 STEEL PIPE AND FITTINGS

A. Pipe 2” and Smaller:

1. Pipe: Schedule 40 black steel, threaded.
2. Fitting: 125# cast iron or 150# malleable iron, screwed.

B. Pipe 2-1/2” and Larger:

1. Pipe: Schedule 40 black steel, grooved except at flanged valves, equipment, etc.
2. Fittings: Grooved, mechanical, bolted, malleable iron, (Victaulic) except at flanged valves, fittings, and equipment where fittings shall be 125# flanged galvanized cast iron.

2.3 LISTED FIRE-PROTECTION VALVES

A. Refer to Section 21 05 23.

2.4 SPRINKLERS

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

1. Globe Fire Sprinkler Corporation.
2. Reliable Automatic Sprinkler Co., Inc.
3. Tyco Fire & Building Products LP.
4. Victaulic Company.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

C. Sprinkler Heads – All sprinkler heads shall be extended coverage type:

1. Type “C” – Concealed, Ceiling: Type “C” heads shall be Reliable Model “G1”, concealed pendent, sprinkler, 165° with ½” orifice, 1” filed adjustment and white cover plate assembly. **Sprinkler heads must be centered in ceiling tiles.**
2. Type “E” – Exposed, Pendent: Type “E” heads same as Type “D” heads except heads shall be pendent.
3. Heads must be centered in ceiling tiles, unless shown otherwise on the drawing.
4. Provide three (3) extra sprinkler heads of each type and wrenches in a steel cabinet to be located where directed by Owner or Engineer. Stock of extra heads to include all ratings and types installed.

2.5 Drain and Test Connections

A. Drain and test connections for all systems shall each consist of 1” gate valve and 1” hose connection with cap. Install test connections where required by code and drain connections at all low points in system. Contractor may substitute SURE-TEST inspectors test and drain valves for the above valves. Extend valve discharges to outside of building, or over a floor drain or janitor’s closet if approved by the Engineer and Owner.

2.6 ALARM DEVICES

A. Refer to Section 21 05 00.

2.7 PRESSURE GAGES

A. Refer to Section 21 05 00.

2.8 ESCUTCHEONS

A. Refer to Section 21 05 00.

2.9 SLEEVES

A. Refer to Section 21 05 00.

2.10 SLEEVE SEALS

A. Refer to Section 21 05 00.

2.11 GROUT

A. Refer to Section 21 05 00.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 SERVICE PIPING

A. Connect sprinkler piping to existing water-service piping at various locations throughout the building.

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Engineer before deviating from approved working plans.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install alarm devices in piping systems.

K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/2 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

M. Fill sprinkler system piping with water.

N. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Division 21 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Division 21 Section "Fire-Suppression Systems Insulation."

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

3.5 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.6 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels. Center sprinkler heads in ceiling tiles.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.7 ESCUTCHEON INSTALLATION

A. Refer to Section 21 05 00.

3.8 SLEEVE INSTALLATION

A. Refer to Section 21 05 00.

3.9 SLEEVE SEAL INSTALLATION

A. Refer to Section 21 05 00.

3.10 IDENTIFICATION

A. Refer to Section 21 05 53.

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run excess-pressure pumps.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.12 CLEANING

A. Clean dirt and debris from sprinklers.

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

3.13 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.14 PIPING SCHEDULE

A. Refer to Part 2.

3.15 SPRINKLER SCHEDULE

A. Refer to Part 2.

END OF SECTION 21 13 13

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SECTION 22 00 00 – PLUMBING WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes a summary of all Plumbing related work.

B. Related Sections:
1. 22 05 00 – COMMON WORK RESULTS FOR PLUMBING
2. 22 05 17 – SLEEVES AND SLEEVE SEALS
3. 22 05 18 – ESCUTCHEONS FOR PLUMBING PIPING
4. 22 05 29 – HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
5. 22 05 53 – IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
6. 22 07 00 – PLUMBING INSULATION
7. 22 08 00 – COMMISSIONING OF PLUMBING
8. 22 11 16 – DOMESTIC WATER PIPING
9. 22 13 13 – FACILITY SANITARY SEWERS
10. 22 13 16 – SANITARY WASTE VENT SYSTEM
11. 22 13 19 – SANITARY WASTE PIPING SPECIALTIES
12. 22 14 13 – FACILITY STORM DRAINAGE PIPING
13. 22 14 23 – STORM PIPING
14. 22 40 00 – PLUMBING FIXTURES

C. Work by Others:
1. The following work will be done by other contractors, as specified under respective headings, which this contractor shall read to ascertain what is called for therein:
    a. Fire Protection
    b. HVAC
    c. Direct Digital Controls (DDC)
    d. Electric

1.3 PROJECT CONDITIONS

A. Description of New Plumbing Systems
1. The following work will be done by this contractor.
2. The contract shall include the installation of the work as shown, specified, or required, and shall include the following:
    a. Install plumbing fixtures.
    b. Install new domestic hot and cold water to plumbing fixtures.
    c. Install new vent lines from plumbing fixtures.
    d. Extend new CWS and CHR piping from new AHU.
    e. Install new sanitary piping.
    f. Install new roof drains and secondary roof drains.
    g. Install new storm piping.
    h. Install required condensate drain piping.
    i. Relocate existing sanitary piping.

j. Relocate existing grease interceptor.
k. Relocate existing cleanouts.
l. Replace existing roof drains.
m. Insulate certain piping as specified.

3. All work shall be performed in strict accordance with the rules, regulations, and drawings of The City, The County, the local Water Department, the local Sewer Department and the Plumbing Division of the State Health Department.
4. The contractor shall exercise adequate protective and safety measures for all persons and property and shall be responsible for any damages or injuries arising from the execution of this work.
5. Unless otherwise noted herein, the contract shall be based on performing the work during regular working hours; if Owner directs any of the work to be executed a times involving overtime pay, the actual added cost of the premium portion of the overtime pay shall be added to the contract amount without markup for overhead and/or profit.
6. Installation of systems shall include the requisite rigging, hauling, protection of equipment and the building structures, and cleaning up. Care shall be exercised to keep dust and dirt to a minimum. All debris shall be promptly removed.

B. Installation of Pipe
   a. Roughing-in and locations of wastes shall be installed as near like the drawings as possible. Where the drawings indicate that the waste exceeds the code requirements, the roughing-in shall be installed in accordance with the drawings and not only to meet the minimum code requirements. Where unforeseen conditions will not permit the installation as shown, no water, waste, etc. lines shall be relocated without the written approval of the Engineer.
   b. All piping located in pipe spaces must be located so as to insure maximum accessibility. Where necessary to cross pipe space, the crossing must be near the floor or 6 feet or more above the floor.

C. Restoration of Surfaces
   1. Refer to Division 01.

D. Guarantee
   1. This contractor shall guarantee all workmanship, materials, and equipment entering into this contract for a period of two years; all from date of substantial completion or from the "recognized" start-up date, whichever is later. Should the Owner elect to accept a portion of work prior to the date of substantial completion, the guarantee period for the accepted portion of the work shall commence on the date of acceptance or on the "recognized" start-up date for that portion of the work, whichever is later. If the specifications dictate a different period of guarantee for a given component or piece of equipment, the more stringent requirements shall govern.
   2. The "recognized" start-up date shall be defined as that date on which the contractor has successfully completed all phases of his work, including the following:
      a. Submitted and received approval of three (3) copies of the Instruction Booklets.
      b. Submitted complete "As-Built" drawings.
      c. Completed all testing, cleaning, adjusting, and trial run.
   3. In the case where the Engineer is accepting a portion of the work, the contractor shall have completed all phases of that portion of the work to be accepted, including Items above, for that accepted portion of the work.
   4. Any workmanship, materials, or equipment proving to be defective during this guarantee period shall be made good by this contractor without additional cost to the Owner.

E. Equipment
   1. Any and all costs associated with piping, electric, wiring, conduit, supports, pads, or other modifications to accommodate installation for manufacturer’s equipment that differs from equipment layout on drawings shall be included on contractor’s bid. The contractor is responsible to insure that the equipment will fit within space allocated with appropriate clearances for maintenance, operation, servicing, and code.

F. Schedule
   1. The contractor shall be responsible to meet the project schedule as stated by the General Contractor. The contractor shall include in his bid the cost associated with all requisite coordination.
   2. In addition, the contractor must prepare a schedule for his work that integrates with the General Contractor's schedule. The contractor shall update progress and revise schedule at least twice monthly.
   3. This contractor shall be responsible to expedite any materials and work any overtime in order to meet the schedule. The cost for any expediting of overtime work shall be included in his bid.

END OF SECTION 22 00 00

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SECTION 22 05 00 – COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General Conditions, Special Conditions and Division 1 through Division 32 as set forth in these specifications are hereby incorporated into and shall become a part of the specifications for work under this Section.

B. Furnish material, labor, tools, accessories and equipment to complete and leave ready for operation of the Plumbing system for this project as described in these specifications and as shown on the drawings, or as required.

1.2 REGULATORY REQUIREMENTS

A. Conform to all utility company regulations.

B. Secure and pay for all necessary permits, fees and inspections and prepare all drawings required by applicable local and state codes.

C. Obtain all inspections or additional permits required by all laws, ordinances, rules, regulations or public authority having jurisdiction and obtain certificates of such inspections and permits and submit same to the Architect. The Contractor shall pay all fees, charges and other expenses in connection therein for plumbing work including inspection fees, etc. associated with the building permit.

D. Perform all work in strict accordance with all applicable laws, codes, regulations and rulings of State, City, County, Local, Utility Company, EPA and requirements of all authorities having local jurisdiction. In case of conflict between the drawings and/or specifications and the above requirements, the more rigid requirements shall govern.

E. Unless otherwise noted, the following latest enforced Edition shall apply to this work:

1. State and Local Plumbing Code
2. Sewer Department
3. Water department
4. National Fire Protection Association
5. Life Safety Code
6. Fire Code
7. Building Code
8. OSHA Requirements
9. EPA Requirements
10. County Building Requirements
11. City Fire Department Requirements
12. City Building Requirements
13. Public Schools Building Requirements

1.3 QUALIFICATIONS

A. Installer: Company specializing in performing work of this Section with minimum three years documented experience.

1.4 MATERIALS, MANUFACTURERS AND SUBSTITUTIONS

A. Unless otherwise specifically indicated, furnish materials and equipment which are new.

B. When two or more products are named together in the specifications, bids shall be based upon any of the products named upon consideration of the following requirements. The product named first has been used in the design.

C. The bidder shall ascertain that the product upon which he chooses to base his bid has the specific features enumerated and is equal, that it will properly fit the space and the adjacent work. Any additional costs, including cost of work by others, involved in completing the work with said products and the responsibility for its fitting and operating as a part of the system rests solely with the bidder.

D. These specifications permit the bidder to propose for consideration with his bid and must be indicated on the substitution sheet, any one of a like material that is generally considered to be equal to the manufacturers named in the specifications. However, the bidder shall base his bid on the name or make of any article, device, material, form of construction, fixture, etc., named in the specifications.

1.5 WARRANTIES

A. In addition to requirements of Division 1, contractor shall turn over to the Owner all certificates of equipment guarantee and/or warranty covering remaining guarantee and/or warranty period at end of his guarantee period.

B. In addition to requirements of Division 1, provide all services necessary to assure the proper operation of all systems installed under this section of the specifications for one year after final acceptance. Completely inspect the systems at least twice during that time, at the change of seasons, and make any necessary adjustments in system. Two weeks before the date for beginning each of the inspections, inform the Engineer in writing. The requirement for inspections is not intended to, nor is the contractor obligated to perform any work during the one year period which, in the opinion of the Engineer is normal maintenance. However, if faulty or defective parts are found during the inspections repair or replace them in accordance with the guarantee provisions of these specifications.

C. In addition to compliance with the Conditions of the Contract, the Contractor is hereby made aware that certain manufacturer's equipment guarantees are valid only for a period of one year from the date of shipment or installation and will, therefore, not be valid until the date of guarantee set forth herein. The Contractor will, therefore, be responsible for all material, labor, and equipment for the full guarantee period as set forth herein.

D. Furnish labor and material required to fulfill the requirements of this guarantee at no additional cost to the Owner.

E. Owner pre-purchased equipment is not to be included in contractor's warranty. However, pre-purchased equipment installation is to be included in the contractor's warranty.

1.6 QUALITY ASSURANCE

A. The Plumbing Contractor shall be responsible for all costs associated with changes to valve, pipe sizes, sprinkler heads, etc. caused by the change of equipment from the basis of design specified to other named manufacturers. The Contractor is responsible to insure that the other

manufacturer named supplied equipment will fit within space allocated, with appropriate clearances for maintenance, operation, service, code requirements, etc. Any contractor utilizing a manufacturer other than basis of design shall be responsible for any additional requirements for electrical service, concrete pad size, physical space limitations, and capacities at no additional cost to Owner. If manufacturers are listed, no other manufacturers except those listed within the Sections of this Division, that are in turn able to comply with the contract document requirements and minimum standards of these specifications, will be acceptable.

B. Work provided or performed by the Contractor shall be guaranteed to be replaced and made good at his own expense any defects which may develop, within one (1) year after final payment and acceptance by Owner, due to faulty workmanship or material, upon receipt of written notification of the defect from the Owner.

1.7 SUBMITTALS

A. Submit under provisions of Division 1.

B. Proposed Products List: Include Products specified in Sections 22.

C. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.

D. Mark dimensions and values in units to match those specified.

E. Submit prior to any shop drawing submittals for the Engineer's review: A proposed list of equipment to be submitted 7 days after letter of intent or award of contract, whichever is first.

F. In addition to provisions of Division 1, (1 set) of shop drawings and (1) electronic set having each sheet (except pages bound in a brochure) and each brochure marked with identification, and containing information described below. To facilitate coordination, submit all drawings in logical order. Submit mechanical assembly drawings, where possible, complete with all related subassembly drawings, wiring diagrams and necessary data.

G. Identification to Include:

1. Project name.
2. Identification by specification heading number under which equipment or material is described and by name, number, and intended use as designated by contract drawings and specifications.
3. Information: Include the following data:

    a) Manufacturer's model number or catalog number, size and performance curves and data. Indicate operating points on curves and tabular data, for each piece of equipment that curves or data represent.
    b) Indication of all performance data, construction materials, finishes and modifications to manufacturer's standard design called for in specifications.
    c) Roughing in, foundation and support points dimensions.
    d) Electrical information, including elementary diagrams, connection diagrams and nameplate data.

4. Any shop drawings not in compliance with above will be returned, without review, for correction and re submittal.
5. In addition to the above, provide shop drawings for the following items:

    a) Coordination drawings.
    b) Maintain one copy of approval documents on site.

1.8 COORDINATION DRAWINGS

A. General:

1. The Mechanical Contractor shall be in charge of the coordination drawing process and shall be responsible to resolve all conflicts and settle any disputes resulting from the coordination drawing process.
2. Contract drawings are diagrammatic. Included in the base bid shall be all offsets, fittings, etc. for a completed project. Only if major rerouting of piping is required, with significant cost increases, as approved by the Owner's Representative, Architect and Engineer, will additional money be warranted.
3. Field discrepancies shall be resolved by the field foreman. When discrepancies cannot be resolved, the signed-off coordination drawings shall be re-examined for rights.
4. Documented, coordinated, dimensioned work will have precedence. Owner will not pay for rework of a particular trade. Uncoordinated work will not be tolerated.
5. Coordination drawings shall be a phased process with the General Contractor, MEP Contractors, Architect and Engineer determining the sequence of work.
6. Each Contractor shall coordinate the exact location of their work with the work of other trades prior to fabrication or installation of same. Verify all dimensions and elevations. Provide additional offsets and sections of material as may be required to meet the applicable job condition requirements. Coordinate with and review all related Construction Drawings and Shop Drawings of all equipment suppliers prior to start of work.

B. Process

1. The Sheet Metal Sub-contractor shall have precedence for the allotment of available space. Ductwork rerouting for gravity drain lines may be required and shall be approved by the Engineer.
2. The Sheet Metal Contractor shall be responsible for all trades, pre-coordinating their layouts and shop drawings with each other, including the Sheet Metal Contractor.
3. The Sheet Metal Contractor shall prepare drawings in ACAD Release 2007 or newer edition. All ACAD files shall be saved suitable for release 2007. He shall be responsible for the base drawings to be used by all other Contractors. Base drawings shall include architectural, structural and reflected ceiling plan information.

4. The Sheet Metal Contractor shall prepare ductwork drawings, at a minimum scale of 1/4" = 1'-0", in ACAD Release 2007 or newer edition. After he has finished a 3-1/2" diskette or CD with base drawing and ductwork shall be circulated in the following order:

    a) Plumbing Contractor
    b) Piping Contractor
    c) Fire Protection Contractor
    d) Electrical Contractor
    e) General Contractor

5. Each Contractor shall use the diskette for preparation of their installation drawings.
6. After all trades have completed the coordination process, the General Contractor shall hold a coordination meeting to resolve conflicts. Each Contractor shall have available a drawing of his layout to be used with a light table for overlaying purposes. A representative of each Contractor, the Architect and the Engineer shall attend. All conflicts shall be resolved at the coordination meeting. The Architect and Engineer shall resolve all major conflicts as to the degree each Contractor shall alter their layout in order to allow for sufficient space for installation of the work.
7. When all coordination is complete, the Sheet Metal Contractor shall distribute two (2) sets of prints of the coordination drawings to each of the trades involved in the project, one (1) set for the owner's representative and one (1) set for as-built drawings.

C. Plumbing, HVAC Piping, Fire Protection and Electrical Contractors:

1. Piping and conduits shall be located and dimensioned from column center lines. Size, center line elevation and required pitch shall be clearly noted.

2. Long drain lines shall have center line elevations indicated at 20’ intervals.

D. General Contractor:

1. All furring and holes shall be clearly noted.
2. All ceiling heights shall be clearly noted.

E. Service Areas:

1. Contractors shall indicate service areas for all equipment by shaded areas on drawings.

1.9 OPERATING INSTRUCTIONS

A. Instruct the Owner's personnel in the details of operation and maintenance of all Contractor furnished equipment. Instructions shall be based on operating manuals furnished for the equipment and shall demonstrate procedures and methods described in manuals.

B. Arrange and pay for the services of qualified personnel from the manufacturer's of various major equipment for instruction. Provide this operating instruction for three working days of not less than eight hours, starting from the time that the entire system (or if sections are to be started at various times, from the time that each section) is in satisfactory operation. Time spent in making trial runs, changes, or major adjustments not to be included in the instruction time.

C. In addition to requirements of Division 1, provide:

D. Mechanical Booklet and Operations Instructions: Submit three (3) manuals, bound in the best grade hardback, loose-leaf, 3-ring binders, of all operating and maintenance instructions presenting full details for care and maintenance of all mechanical and electrical equipment installed, including air conditioning systems and equipment. The operating instructions shall include the following information:

1. Operating Instructions Manuals:

a) Provide written instructions for each system with submittal of invoice for 75% of total contract.
b) Submit one copy for approval before releasing to the Owner.
c) Upon receipt of the approval, submit three copies to the Engineer.
d) Bind the written operating instructions, shop drawings, equipment catalog cuts and manufacturer's instructions into a hard backed binder where they can be accommodated into a size 8-1/2" X 11".

2. Provide multiple binders where one cannot accommodate information.

a) First Page - Title of job, Owner, address, date of submittal, name of Contractor and name of Engineer.
b) Second Page - Index or Table of Contents.
c) Third Page - Introduction to first section containing a complete written description of systems.
d) First Section - Written description of system contents, where actually located in the building, how each part functions individually, and how system works as a whole. Conclude with a list of items requiring service and either state the service needed or refer to the manufacturer's data in the binder that described the proper service.
e) Second Section - A copy of each shop drawing with an index at the beginning of the section.
f) Third Section - A copy of each manufacturer's installation instructions.
g) Fourth Section - A copy of each manufacturer's operating instructions and parts lists along with recommended spare parts lists with index at the beginning of the section.
h) Fifth Section - A copy of each manufacturer's maintenance instructions
i) Sixth Section - A list of all equipment used on the job, Contractor's purchase order numbers, supplier's name and address, date of start-up of each piece of equipment.

j) Seventh Section - Copies of all control wiring and flow diagrams, valve charts, pertaining to the work including automatic temperature control diagrams.

1.10 RECORD DRAWINGS

A. In addition to Division 1, keep on the job one complete set of working drawings on which he shall record any deviation or changes made from contract drawings made during construction. Record drawings shall show changes in:

1. Size, type, capacity, etc. of any materials, device, or piece of equipment.
2. Location of any device or piece of equipment.
3. Location of any outlet or source in building service systems.
4. Routing of any piping, conduit, ducts, sewers, or other building services.

B. These drawings shall also record the location of all concealed water and electric service, water piping, sewers, wastes, vents, ducts, conduit and other piping by identification of measured dimensions to each such line from readily identifiable and accessible walls or corners of the building. Drawings also show invert elevation of sewers and top of water lines.

C. These drawings shall be kept clean and undamaged, and shall not be used for any purpose other than recording deviations from working drawings and exact locations of concealed work.

D. After the job is completed these sets of drawings shall be delivered to the Engineer in good condition, as a permanent record of the installation as actually constructed.

1.11 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification sections.

B. Deliver to owner to location as directed; obtain receipt prior to final payment.

1.12 DRAWINGS AND SPECIFICATIONS

A. It is intended that work covered by these specifications and drawings include everything requisite and necessary to make the various systems complete and operative, irrespective of whether or not every item is specifically provided for. Any omission of direct reference herein to any essential item shall not excuse contractor from complying with the above intent.

B. Figured dimensions supersede scaled ones. Contractor shall take no advantage of, and shall promptly call the Owner's Representative attention to any error, omission or inconsistency in specifications and drawings.

C. Special attention is directed to requirements that equipment and materials stated in specifications and/or indicated on drawings shall be furnished, except if otherwise noted, completely installed, adjusted and left in safe and satisfactory operating condition. Accessories, appliances and connections necessary for operation of equipment shall be provided to satisfaction of the Owner's Representative.

D. Materials, apparatus or equipment specified or otherwise provided for on drawings, addenda, or change orders issued subsequent to award of contract shall be same brand, type, quality and character originally specified unless otherwise provided.

E. Layout of equipment, accessories, specialties and suspended, concealed or exposed piping systems are diagrammatic unless dimensioned. In preparing shop drawings, contractor shall check project conditions before installing work. If there are any interferences or conflicts, they shall be called to attention of the Engineer immediately for clarification.

F. The drawings indicate required size and points of termination of pipes and ducts and suggest

proper routes to conform to structure avoid obstructions and preserve clearances. However, it is not intended that drawings indicate all necessary offsets, and it shall be the work of this contractor to make the installation in such a manner as to conform to structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further obstruction or cost to the Owner.

G. Shop drawings shall be furnished by this contractor, indicating all changes to meet space requirements, code requirements and as necessary to resolve all space conflicts. Ductwork shall be fabricated from contractor's shop drawings and cut sheets and not from contract drawings.

H. It is intended that all apparatus be located symmetrical with architectural elements, and shall be installed at exact height and locations as shown on the architectural drawings. Refer to architectural details in completing and correlating work.

I. The contractor shall fully inform himself regarding any and all peculiarities and limitations of the spaces available for the installation of all work and materials furnished and installed under the contract. He shall exercise due and particular caution to determine that all parts of his work are made quickly and easily accessible.

J. The contractor shall carefully examine any existing conditions, existing piping and ducts and premises and compare the drawing with the existing conditions.

K. It cannot be too strongly emphasized that, except for work specifically excluded herein, every system shall be turned over to Owner installed completed, with components, ready for normal operation.

L. Modify existing systems by rerouting for systems to remain or remove for abandoned systems as required to accommodate new general construction, Fire Suppression, electrical and mechanical work.

M. Concealment:

1. Unless otherwise specified, all work aboveground to be above suspended ceilings and in walls except in the Mechanical Equipment Room and areas without ceiling work to be as high as possible.

PART 2 - NOT APPLICABLE

2.1 NOT USED

PART 3 – EXECUTION

3.1 PROJECT CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by Project conditions.

B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Owner Representative before proceeding.

C. Drawings indicate desired position of equipment and routing of pipe and ductwork. Coordinate routing of pipes, ductwork and all other installations with installations of other trades prior to making installations.

D. Replace and restore to their original undamaged condition, facilities of every description damaged or disturbed during progress of work. Such replacement or restoration applies to both surface and subsurface installations and materials. This includes fences for security, access routes, sidewalks, etc.

E. Where cutting of building structure such as floors, walls, roof, or framing is necessary, perform

cutting operations only as authorized by the Owner's Representative as specified in Division 2. Cutting and patching of existing and new facilities shall be included in this Contract. Patch and finish all such openings in accordance with the applicable requirements given in other sections of these specifications.

F. Patching shall be done by workmen skilled in the trade involved. Holes cut in structural steel must be drilled or punched, not burnt with torch.

G. Remove existing ceiling and replace after work is tested. Repair and/or replace any damaged materials as directed by the Owner's Representative. Cutting and patching by this contractor to be as specified in Architectural Sections.

H. Patch, close and seal all new and existing openings used by this contractor. Where openings are used by more than one trade, each trade to be responsible for an equal share of patching, closing and sealing openings.

I. Tie-in to existing installations as indicated on the drawings and specified hereinafter. Complete the work to assure proper operation of each system with least possible damage to an interference with surrounding construction and using materials specified or to match existing.

3.2 SEQUENCING AND SCHEDULING

A. Construct Work in sequence under provisions in Division 1.

B. Coordinate completely all phases of and scheduling of work with the Owner’s Representative and with other trades. Obtain approval from the Owner’s Representative prior to execution of any work.

C. The existing facilities will remain in service throughout the construction operation with brief shut down periods permitted for making tie-in connections.

D. Interruption of existing services and facilities will be permitted only when the facilities are not required. The cost of premium time for scheduling interruptions on weekends and during evening hours as required by the Owner’s Representative operating schedule to be included in the bid amount. This means that both the cost of doing the work during the normal working day and the premium charges for weekend and evening hours to be included in the bid amount.

E. Make temporary connections where and when necessary to maintain existing systems in operation and replace temporary connections with permanent connections as soon as possible.

3.3 PRODUCT DELIVERY, STORAGE AND HANDLING

A. In addition to Division 1, protect piping ductwork and equipment at all times against entrance of dirt and injury to pipe joints, sheet metal, sheet metal acoustical lining and equipment surfaces during construction by means of caps, plugs, canvas, mounting
on skids or plastic covers.

B. During shipment and before and during erection, protect materials and equipment from weather damage. Keep materials and equipment off ground by means of wood blocks or skids. Follow manufacturer's suggested procedure for protection of equipment which will be idle for an extended period of time prior to start-up.

3.4 DEMOLITION

A. Disconnect all systems piping, ductwork, equipment, trim and accessories that are to be removed from systems that are to be maintained and used in the existing facility. Cap or plug all systems that are to remain in service. Demolition work to be scheduled as directed by the Owner's Representative. All costs for temporary connection to maintain the existing systems in operation after demolition of portions of the facility to be included in this contract. This contract to do all

demolition shown on the drawings. All systems not reused are to be removed from the facility unless indicated otherwise.

B. Building demolition that is to be done by the General Contractor is specified in Division 2. Do all demolition work not done by the General Contractor. This includes abandoned systems in walls, ceilings and chases that remain.

C. Demolition to include all cutting, patching, excavation, backfill, removal and reworking all items in accordance with the applicable requirements given in other sections of these specifications.

D. Patch all walls, floors, roofs, ceilings where mechanical items are removed to provide finished surfaces to match adjacent surfaces.

3.5 EXCAVATION AND BACKFILL

A. Perform all excavation and backfill required to complete the working accordance with Division 32 Earthwork. Protect excavations, barricade walkways and minimize pedestrian disruption.

3.6 CONCRETE WORK

A. Provide all concrete pads and do all concrete work in accordance with Division 3.

3.7 PROTECTION AND DAMAGE

A. In addition to the provisions and stipulation of the General Conditions, provide various types of protection as follows:

1. Protect finished floors from chips and cutting oil by the use of metal drip receiving pan and oil proof floor cover.
2. Protect equipment and finished surfaces from welding and cutting splatters with baffles and splatter blankets.
3. Protect equipment and finished surfaces from paint droppings, insulation adhesive and sizing droppings, etc. by use of drop cloths.

B. All equipment shall be stored at the site with openings, bearings, etc., covered to exclude dust and moisture. All stock piled pipe shall be placed on dun age and protected from weather and from entry of foreign material.

C. Piping and construction openings and excavations required for Plumbing work shall be covered when work is not in progress as follows:

1. Cap pipe openings with fittings or plugs.
2. Cover wall and ceiling openings with plywood, or canvas covered framing.
3. Cover floor openings and excavations with structural material of adequate strength to support traffic.

D. The Owner’s property and the property of other Contractors shall be scrupulously respected at all times (including damage from leaks). Provide drop cloths and visqueen or similar barriers where dust and debris is generated, to protect adjacent area.

E. Contractor shall be held responsible for damage caused by his work or through neglect of his workmen. Repairing of damaged work shall be done by Contractor as directed by the Architect. Cost of repairs shall be paid by Contractor.

F. The Owner reserves the right to make emergency repairs as required to keep equipment in operation without voiding the Contractor=s guarantee bond not relieving the contractor of his responsibilities during the bonding period.

3.8 TESTING AND ADJUSTING

A. Furnish all necessary temporary equipment and instruments required for adjustments and for operating tests. Submit list of instruments which will be used, including data of most recent calibration of each instrument.

B. When a test is to be made, notify the Owner's Representative not less than 48 hours before the test is scheduled to start, so that he may witness the test, or any part of it, if they elect to do so. The start of any test or handling system may also be deferred by not more than two working days if the proposed date conflicts with other commitments of the personnel assigned to witness the tests.

C. Pressure Tests:

1. Test piping and prove tight, at the hydrostatic pressures Test piping which is to be concealed before the installation of concealing construction is started. Disconnect devices, equipment and attached piping which are not designed for the test pressure, and install plugs and blind flanges to close openings. listed below for a period of 2 hours for each test:
2. Water piping, Storm, soil, waste, vent and drain piping - test with water or air, prove tight to satisfaction of inspection authorities and architect/engineer. Natural gas piping test to 75 psig with compressed air.
3. Replace work found defective, or repair if so directed.

D. Soil test per Division 32.

E. Equipment:

1. After satisfactory testing and cleaning of all piping as specified herein, placement all equipment in operation. Pressure test equipment to rated pressure for a period of 2 hours.
2. Take all necessary reading to determine that equipment is operating satisfactorily. This includes temperatures in and out as well as ampere readings and voltage readings of all phases.

F. Adjusting and Balancing:

1. After satisfactory testing and cleaning of all piping as specified hereinbefore, place all equipment in operation and adjust as required for proper operation.
2. For starting-up and adjusting of Contractor furnished equipment except as specified hereinafter, which is not within the normal function of the Contractor's personnel, arrange and pay for the services of employees of the manufacturer's of various major items of equipment to supervise such adjustment and initial operation.
3. If the Contractor elects to provide such service for any equipment with his own personnel, and this proves unsatisfactory in the opinion of the Owner's Representative, the Contractor shall, upon notification of such dissatisfaction, arrange immediately for services of manufacturer's employees as specified above.
4. Contractor shall add to systems any devices required for proper balancing.

G. Test Reports:

1. After all tests have been completed, or at intervals during the testing if requested by the Owner's Representative, submit data on motor load readings on each phase and simultaneous voltage readings across each phase with motor nameplate data.

3.9 OPERATION OF SYSTEM

A. After the entire system has been adjusted, operate it for not less than three working days of not less than eight hours each to demonstrate that performance is satisfactory and that each item of equipment has the capacity specified. If the Engineer agrees or directs major portions of the system may be so operated at different times in lieu of operations of the entire system at once. Correct all operating deficiencies observed during the test runs.

B. When excessive vibration of equipment is noted during this operation, have the manufacturer's

representative check shafts, motors, motor supports, fan wheels, sheaves, equipment mountings, bearings and couplings and other components of the equipment which are vibrating.

C. Make all corrections necessary to eliminate the vibration to the satisfaction of the Engineer.

D. When the Engineer deems it to be necessary to do so, make another test after corrective work is completed for the full period specified above.

E. After replacement or repair, test work again as specified. Repeat until satisfactory.

F. Keep complete and accurate record of test data. Submit to the Owner's Representative, in triplicate, typewritten report of all test data.

G. Provide restraints to eliminate all excess pipe movement.

3.10 ACCESS PANELS

A. Provide access panels where required for access to concealed equipment, valves and piping. Location of all access panels shall be approved by the Architect/Engineer.

B. Panel size shall be adequate for service intended. Use fire rated UL listed access panels in fire rated ceilings or walls.

C. Access panels shall be Milcor Type M, for masonry walls, Type "K" for plaster ceilings or Type "AT" for non-accessible acoustical tile ceiling, or equal, and fire rated type for fire rated ceiling and walls.

D. Access panels shall have Best locks with cores keyed to master key as selected by the sponsor agency.

3.11 FINISH

A. Prime piping and structural and/or supporting steel members or parts that are exposed with one coat of Porter gray primer, or equal, after work is in place.

1. Clean and re-paint any factory or shop painted surfaces that are damaged, scarred or with signs of corrosion. Painting to match original factory paint.
2. Clean surfaces to remove all dirt, oil, grease dust, scale and foreign matter before applying paint. Designate all piping with temporary removal markings for guidance during priming and painting.
3. All primer and paint shall be manufactured by Foy Johnston Porter, Pittsburgh Plate Glass Industries, Martin-Marietta, DuPont or equal.
4. Shop fabricated or Manufactured Equipment and Materials:
5. Unless factory finished is specified, prime, prior to shipment to job. If prior painting is not part of manufacturer's standard procedure, paint equipment and materials immediately after they are put in place, as specified for field painted items.
6. Items not to be painted:
   a) Galvanized or similarly treated surfaces unless furnished as part of unitary assembly.
   b) Non-ferrous surfaces
   c) Non-metallic surfaces
   d) Plated surfaces
   e) Inside of pipes, conduits and electrical devices
   f) Gearing and machine finished surfaces
   g) Underground piping, unless otherwise specified.

B. Painting:

1. Refer to Division 1, for requirements.

2. Clean surfaces to remove all dirt, oil, grease, dust, scale and foreign matter before applying paint.
3. Finish painting to be done per Division 9 - Finishes or as specified within individual sections of this specification.

C. Permanent Identification:

1. After piping has been insulated and finish painted identify all exposed piping with painted stencils.

3.12 FINAL CLEANING

A. In addition to the requirements of Division 1.

B. The Contractor shall provide final cleaning of the work consisting of cleaning each surface or unit of work to normal "clean" condition expected for a first-class building cleaning and maintenance program. Comply with the manufacturer's instructions for cleaning operations. The following are examples, but not by way of limitation, of cleaning levels required:

C. Remove labels which are not required as permanent labels.

D. Clean transparent materials, including mirrors and window/door glass, to a polished condition, removing\substances which are noticeable as vision-obscuring materials. Replace broken glass.

E. Clean exposed exterior and interior hard-surfaced finishes, including metals, masonry, concrete, painted surfaces, plastics, tile, wood, special coatings and similar surfaces, to a dirt-free condition, free of dust, stains, films and similar noticeable distracting substances. Except as otherwise indicated, avoid disturbance of natural weathering of exterior surfaces. Restore reflective surfaces to original reflective.

F. Clean concrete floors broom clean.

G. Clean project site, including landscape, development areas, of litter and foreign substances. Sweep paved areas to a broom-clean condition; remove stains, petro chemical spills and other foreign deposits. Rake grounds which are neither planted nor paved, to a smooth, even-textured surface.

H. Remove all debris and clean dirt free all interiors of air handling equipment including coils, fans, dampers and ductwork. Clean to a visible dust and dirt free condition the inside of ductwork and replace filters on all systems that have been used for temporary heat or ventilation during construction.

3.13 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:
   a) Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
   b) Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
   c) Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
   d) Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast- brass type with polished chrome-plated finish.
   e) Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and spring clips.
   f) Bare Piping in Equipment Rooms: One-piece, cast-brass type.
   g) Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

L. Sleeves are not required for core-drilled holes.

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.
2. 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.
3. Install sleeves in new walls and slabs as new walls and slabs are constructed.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

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.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

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 fire stop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.14 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 equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.

D. Install equipment to allow right of way for piping installed at required slope.

END OF SECTION 22 05 00

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SECTION 22 05 17 - SLEEVES AND SLEEVE SEALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.3 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe with plain ends and integral water stop, unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

A. Product: Subject to compliance with requirements, provide product by one of the following:

1. Smith, Jay R. Mfg. Co.
2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
3. Josam

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts and nuts for membrane flashing.

1. Under deck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Product: Subject to compliance with requirements, provide product by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber 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.

2.4 SLEEVE-SEAL FITTINGS

A. Product: Subject to compliance with requirements, provide product by one of the following:

1. Presealed Systems.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

a. Piping Smaller than NPS 6: Cast-iron wall sleeves, galvanized-steel wall sleeves or galvanized-steel-pipe sleeves
b. Piping NPS 6 and Larger: Cast-iron wall sleeves, galvanized-steel wall sleeves or galvanized-steel-pipe sleeves.

2. Exterior Concrete Walls below Grade:

a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system, galvanized-steel wall sleeves with sleeve-seal system or galvanized-steel-pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system, galvanized-steel wall sleeves with sleeve-seal system or galvanized-steel-pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system, galvanized-steel wall sleeves with sleeve-seal system, galvanized-steel-pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system, galvanized-steel wall sleeves with sleeve-seal system or galvanized-steel-pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves, stack-sleeve fittings or sleeve-seal.
b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves or stack-sleeve fittings.

5. Interior Partitions:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves or PVC-pipe sleeves.
b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 22 05 17

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SECTION 22 05 18 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Escutcheons.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.

g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with rough-brass finish.
k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.

3.2 FIELD QUALITY CONTROL

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

END OF SECTION 22 05 18

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General Conditions, Special Conditions and Division 1 through Division 32 as set forth in these specifications are hereby incorporated into and shall become a part of the specifications for work under this Section.

1.2 SUMMARY

A. This Section includes hangers and supports for mechanical system piping and equipment.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the valve and fittings industry.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents and test water.

B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents and test water.

1.5 SUBMITTALS

A. Product Data: For each type of pipe hanger, channel support system component and thermal-hanger shield insert indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer for multiple piping supports and trapeze hangers. Include design calculations and indicate size and characteristics of components and fabrication details.

C. Welding Certificates: Copies of certificates for welding procedures and operators.

1.6 QUALITY ASSURANCE

A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified:

1. Pipe Hangers:

a. Grinnell Corp.
b. Michigan Hanger Co., Inc.
c. National Pipe Hanger Corp.

d. PHD Manufacturing, Inc.

2. Channel Support Systems:

a. Grinnell Corp.; Power-Strut Unit.
b. Michigan Hanger Co., Inc.; O-Strut Div.
c. National Pipe Hanger Corp.
d. Thomas & Betts Corp.
e. Unistrut Corp.

3. Thermal-Hanger Shield Inserts:

a. Michigan Hanger Co., Inc
b. Pipe Shields, Inc.
c. Rilco Manufacturing Co., Inc.
d. Value Engineered Products, Inc.

4. Powder-Actuated Fastener Systems:

a. Gunnebo Fastening Corp.
b. Hilti, Inc.
c. ITW Ramset/Red Head.
d. Masterset Fastening Systems, Inc.

5. Roof Pipe Support

a. C-Port.
b. Mifab
c. Advanced Support Products
d. Clearline Technologies

2.2 MANUFACTURED UNITS

A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.

1. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.

1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

C. Thermal-Hanger Shield Inserts: 100 psi minimum compressive-strength insulation; encased in sheet metal shield.

1. Material for Cold Piping: ASTM C 552, Type I cellular glass with vapor barrier.
2. Material for Hot Piping: ASTM C 552, Type I cellular glass.
3. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
4. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
5. Insert Length: Extend 2" beyond sheet metal shield for piping operating below ambient air temperature.

2.3 MISCELLANEOUS MATERIALS

A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

C. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.

D. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.

1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
2. Properties: Nonstaining, noncorrosive, and nongaseous.
3. Design Mix: 5000-psi 28-day compressive strength.

2.4 ROOF PIPE SUPPORT

A. Molded recycled rubber support, UV resistant, Maximum 500 pound load, accepts screw fasteners thru pipe clamps, 4” high unit, 2 inch and smaller pipe minimum base size 6” x 9”, for 2-1/2 inch and larger pipe minimum base size 6” x 22”, maximum support spacing 8 or 10 foot. Provide rigid pipe clamps and stainless steel screws (pipe clamp to be one size larger than piping)

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger requirements are specified in Sections specifying equipment and systems.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.

C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes, NPS 2 to NPS 30.

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. Carbon-or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
5. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated stationary pipes, NPS 3/4 to NPS 2.
6. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 2.
7. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 2.
8. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30.
9. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
10. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36 , with steel pipe base stanchion support and cast-iron floor flange.

11. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from two (2) rods if longitudinal movement caused by expansion and contraction might occur.
12. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
13. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.

D. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

E. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32):1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where head room is limited.

F. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi minimum compressive-strength, cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal

shield.

G. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.

3.2 HANGER AND SUPPORT INSTALLATION

A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.

1. Field assemble and install according to manufacturer's written instructions.

C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

D. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

E. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

F. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

H. Install hangers and supports to allow controlled thermal of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.

K. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert. Include steel weight distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
c. Do not exceed pipe stress limits according to ASME B31.9.

2. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
b. NPS 4: 12 inches long and 0.06 inch thick..
c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.

3. Pipes NPS 8 and Larger: Include wood inserts.
4. Insert Material: Length at least as long as protective shield.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

L. Supports from roof decking systems are not permitted.

M. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1” and Smaller: 36" with 3/8" rod.
2. NPS 1-1/4 to NPS 2: 48" with 3/8" rod.
3. NPS 2-1/2 to NPS 3 1/2: 48" with 1/2" rod.
4. NPS 4 and NPS 5: 48" with 5/8" rod.
5. NPS 6: 48" with 3/4" rod.
6. NPS 8: 48" with 7/8" rod.

N. Install supports for vertical CPVC piping every 60 inches for NPS 1 and smaller and every 72 inches for NPS 1-1/4 and larger.

O. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1 and Smaller: 32 inches with 3/8 inch rod.

P. Install hangers for vertical PEX piping every 48 inches.

Q. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2” and Smaller: 48" with 3/8" rod.
2. NPS 2-1/2 to NPS 3 1/2: 48" with 1/2" rod.
3. NPS 4 and NPS 5: 48" with 5/8" rod.
4. NPS 6: 48" with 3/4" rod.
5. NPS 8: 48" with 7/8" rod.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

3.4 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.

B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

A. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9.

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

END OF SECTION 22 05 29

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SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General Conditions, Special Conditions and Division 1 through Division 32 as set forth in these specifications are hereby incorporated into and shall become a part of the specifications for work under this Section.

B. Identify by labels and tags the following:

1. Equipment such as hot water heaters, pumps, etc.
2. Piping and valves exposed in equipment rooms and accessible service areas.
3. Piping and valves running above accessible ceiling construction and near access panels in non-accessible construction areas.

C. Install laminated plastic markers and metal stamped nameplates for equipment. Provide color banding, flow arrows and contents identification for piping and ductwork.

1.2 SUMMARY

A. This Section includes the following mechanical identification materials and their installation:

1. Equipment nameplates.
2. Equipment markers.
3. Pipe markers.
4. Stencils.
5. Valve tags.
6. Valve schedules.
7. 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 three 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. Coordination 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.

D. All trades shall use the same type, style and appearance of identification.

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 Markers: Engraved, laminated plastic, white lettering on black background. Markers shall be screw on, except where screws might damage equipment, use a contact-type permanent adhesive.

1. Terminology: Match schedules as closely as possible.
2. Size: Sized for 3/4-inch lettering.

2.2 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service and showing direction of flow.

1. Colors: As indicated in specification schedule.
2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
3. Pipes with OD, including insulation, less than 6 inches: full wrap around pipe labels extending +360 degrees around pipe at each location.
4. Pipes with OD, including insulation, 6 inches and larger: Either full-band or full wrap around pipe label pipe markers at least three (3) times letter height and of length required for label.
5. Arrows: A separate full wrap around pipe labels with flow direction on each pipe marker to indicate direction of flow (arrows may be part of labels above).

2.3 VALVE TAGS

A. Valve Tags: 2" diameter tag stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme, approved by Engineer. Provide 5/32-inch hole for fastener.

1. Material: 16 gauge brass.
2. Valve-Tag Fasteners: Brass beaded chain.

B. Coordinate with Owner Representative for data on tags with a unique equipment number. The equipment tag shall have the number in both an alpha/numeric font and a bar code font. The number and font shall be obtained from Owner prior to tagging.

2.4 VALVE SCHEDULES

A. Valve Schedules: For each piping system, on standard-size, bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulation), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
2. Frame: Extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 22 Sections. If more than single-type material, device or label is specified for listed applications, selection is Installer's option.

B. Installing Contractor is responsible for valve tagging, equipment markers and pipe identification of all valves, equipment and piping on packaged pumping skids.

3.2 EQUIPMENT IDENTIFICATION

A. Install equipment markers with screws. If screws might damage equipment, use permanent adhesive on or near each major item of plumbing equipment.

1. Locate markers where accessible and visible. Include markers for the following general categories of equipment:

a. Main control and operating valves, including safety devices.
b. Pumps.
c. Hot water heaters.
d. Tanks and pressure vessels.
e. Water-treatment systems and similar equipment.

3.3 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service of 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 non-concealed 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 non-accessible 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.

C. Pipe Identification

TYPE OF SERVICE	DESIGNATION
Domestic Cold Water	DOM.C.W.
Domestic Hot Water Supply	DOM.H.W.S.
Domestic Hot Water Return	DOM. H.W.R.
Storm	STORM
Sanitary	SANITARY
Vent	VENT
Gas	GAS

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves with captions similar to those indicated in the following:

TYPE OF SERVICE	VALVE TAG DESIGNATION
Domestic Cold Water	DCW
Domestic Hot Water	DHW
Domestic Hot Water Return	DHWR
Gas	GAS

3.5 VALVE-SCHEDULE INSTALLATION

A. Mount valve schedule on wall in accessible location where directed by Owner. Provide aluminum frame with plexiglas cover for valve chart.

3.6 WARNING-TAG INSTALLATION

A. Write required message on and attach warning tags to equipment and other items where required.

3.7 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work. Stencils, name tags, etc. must be readable from a standing position.

B. When arrows and letters cannot be stenciled on pipe, stencil identification on 16 gauge aluminum metal panels in correct color and hang panel on piping with key chains.

3.8 CLEANING

A. Clean faces of mechanical identification devices and glass and frames of valve schedules.

END OF SECTION 22 05 53

SECTION 22 07 00 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General Conditions, Special Conditions and Division 1 through Division 32 as set forth in these specifications are hereby incorporated into and shall become a part of the specifications for work under this Section.

1.2 SUMMARY

A. This Section includes pre-formed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

1.3 SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness and jackets (both factory and field applied, if any) for each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for the following:

1. Application of protective shields, saddles and inserts at pipe hangers for each type of insulation and hanger.
2. Insulation application at elbows, fittings, flanges, valves and specialties for each type of insulation.
3. Removable insulation at piping specialties and equipment connections.
4. Application of field-applied jackets.

1.4 QUALITY ASSURANCE

A. Installer: Company specializing in performing work of this Section with minimum three years documented experience.

B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less; and smoke-developed rating of 50 or less.

C. ASHRAE Standards: Comply with performance efficiencies prescribed for ASHRAE 90.1, "Energy Efficient Design for New Buildings, Except Low Rise Residential Buildings" for pipe insulation.

D. No damaged or water soaked insulation shall be used.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers and insulation shields.

B. Coordinate clearance requirements with piping installer for insulation application.

1.7 SCHEDULING

A. Schedule insulation application after testing piping systems. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.

1. Mineral-Fiber Insulation:

a. CertainTeed Manson.
b. Knauf FiberGlass GmbH.
c. Owens-Corning Fiberglas Corp.
d. Schuller International, Inc.

2.2 INSULATION MATERIALS

A. Mineral-Fiber Insulation w/ ASA jacket: Glass fibers bonded with a thermosetting resin complying with the following:

1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
2. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:

a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.

3. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
4. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
5. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

B. Cellular-Glass Insulation: Foamed glass rated for 25/50 fire smoke spread, annealed, rigid, hermetically sealed cells, and incombustible. Preformed Pipe Insulation, with Jacket: Comply with ASTM C 552, Type II, Class 2.

C. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials rated 25/50 fire smoke spread. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Adhesive: As recommended by insulation material manufacturer.

D. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in performing insulation to cover valves.

2.3 FIELD-APPLIED JACKETS.

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. Standard PVC Fitting Covers for all interior insulated fittings: Factory-fabricated fitting covers

manufactured from 20-mil thick, high-impact, ultraviolet-resistant PVC.

1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps and mechanical joints.
2. Cover fittings with insulation prior to fitting cover installation.
3. Adhesive: As recommended by insulation material manufacturer.
4. Rated for 25/50 fire smoke spread if used in return air ceiling plenums.

C. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes for all exterior insulation. Comply with ASTM B 209, 3003 alloy, H-14 temper.

1. Finish and Thickness: Stucco-embossed finish, 0.020-inch thick.
2. Cover fittings with insulation prior to fitting cover installation
3. Moisture Barrier: 1-mil thick, heat-bonded polyethylene and kraft paper.
4. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish and thickness as jacket.

D. Glass Cloth Covering: Self-adhesive, mastic impregnated, rewettable cloth on exposed insulation and fittings in all occupied areas.

1. Thickness: 0.028 inches
2. Maximum Service Temperature: 450 degrees F.
3. Density: 14.3 oz/sq yd
4. Surface Burning Characteristic: 25/50 per ASTM E84

2.4 ACCESSORIES AND ATTACHMENTS

A. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:

1. Aluminum: 0.007 inch thick.

B. Wire: 0.080 inch, nickel-copper alloy; 0.062 inch, soft-annealed, stainless steel; or 0.062 inch soft-annealed, galvanized steel.

C. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave pre-sized a minimum of 14.3 oz/sq. yd.

1. Tape Width: 4 inches.

2.5 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets and substrates.

2.6 CELLULAR FOAM

A. Manufacturers:

1. Armstrong Model AP.
2. Other acceptable manufacturers offering equivalent products:

a. Halstead Mitchell.
b. Rubatex

B. Insulation: ASTM C534; flexible, cellular elastomeric, molded or sheet.

1. 'K' Value: ASTM C177 or C518; 0.28 at 75 degrees F.

2. Minimum Service Temperature: -40 degrees F.
3. Maximum Service Temperature: 220.
4. Maximum Moisture Absorption: ASTM D1056; 1.0 percent (pipe) by volume, 1.0 percent (sheet) by volume.
5. Moisture Vapor Transmission: ASTM E96; 0.20 perm inches.
6. Maximum Flame Spread: ASTM E84; 25.
7. Maximum Smoke Developed: ASTM E84; 50.
8. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive

1. Manufacturers:

a. Armstrong 520.
b. Foster.
c. Halstead 950.
d. Rubatex R-373.

2. Air dried, contact adhesive, compatible with insulation.

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.

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

3.2 PREPARATION

A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves and specialties.

B. Refer to schedules at the end of this Section for materials, forms, jackets and thicknesses required for each piping system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.

E. Apply 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. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

H. Keep insulation materials dry during application and finishing.

I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

J. Apply insulation with the least number of joints practical.

K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves and specialties.

L. Hangers and Anchors:

1. Apply insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support and shield.

M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.

O. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
2. Circumferential Joints: Cover with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply 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 4 inches o.c.

    a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.

4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

P. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.

Q. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

R. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.

1. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Fire Stopping."

S. Floor Penetrations: Apply insulation continuously through floor assembly.

1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

3.4 MINERAL-FIBER INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.
3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches on center.
4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
5. All exposed ends for mineral fiber insulation shall be neatly trimmed and beveled. All exposed insulation material shall be covered with mastic.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the 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. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions and cover with insulating cement troweled smooth.
2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with tape and cover with insulating cement troweled smooth.
3. Cover fittings with standard PVC fitting covers.

D. Apply insulation to valves and specialties as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.

3.5 CELLULAR-GLASS INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of insulation to pipe with wire, tape, or bands without deforming insulation materials.
2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-

retarder mastic.

3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
5. All exposed ends for cellular-glass insulation shall be neatly trimmed and beveled. All exposed insulation material shall be covered with mastic.

3.6 FIELD-APPLIED JACKET APPLICATION

A. Apply aluminum metal jacket for all exterior water piping, with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal joints with weatherproof sealant recommended by insulation cover manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

B. Glass Cloth Covering: Self-adhesive, mastic impregnated, rewettable cloth on exposed insulated pipe and fitting covering in all occupied areas.

C. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to pipe sizes on insulated pipe and fitting covering in all exterior exposed areas.

3.7 PIPING SYSTEM APPLICATIONS

A. Materials and thicknesses for systems listed below are specified in schedules within this section.

B. Insulate the following piping systems:

1. Insulate hot water supply and return piping with glass fiber insulation.
2. Insulate city water supply piping with glass fiber insulation.

C. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials and equipment:

1. Flexible connectors.
2. Vibration-control devices.
3. Fire-suppression piping.
4. Below-grade piping, unless otherwise indicated.
5. Chrome-plated pipes and fittings, unless potential for personnel injury.
6. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.

D. MINIMUM INSULATION THICKNESS FOR PIPE SIZES

PIPING SYSTEM TYPES	FLUID TEMPERATURE RANGES (DEG. F)	LESS THAN 1" (INCHES)	1" TO 1-1/2" (INCHES)	1-1/2" AND 3" (INCHES)	4" LARGER (INCHES)
Hot Water	105+	0.5	0.5	1.0	1.0
City Water	Any	0.5	0.5	1.0	1.0
Hot Water Return	Any	0.5	0.5	1.0	1.0
Horizontal storm	Any			1.0	1.0

Roof Drain sumps	Any	1.0	1.0

NOTE: The minimum listed thickness is based on a minimum R valve of 4.6. Thickness to vary if the insulation R value is different than 4.6. In addition, the minimum thickness is to be increased as required to meet ASHRAE 90.1-Table 6.8.3.

CELLULAR FOAM PIPING SYSTEMS	PIPE SIZE	INSULATION THICKNESS
Domestic Cold and Hot Water Individual Run-Outs	All	1/2"
Roof Drain Sumps	All	1/2"
Horizontal Storm Piping	All	1/2"
Floor Drain Piping System As Indicated	All	1/2"

E. Insulation at fire walls: All insulated piping penetrating walls with a fire resistive rating shall be insulated with molded foamglass; AASJ-SSL@ covering with a dual purpose fireproof, kraft aluminum foil, laminated white jacket. Insulation to be of same thickness as adjoining insulation.

F. PIPE INSULATING SUPPORT

1. On insulated piping with pipe supports around outside of covering provide galvanized steel formed bearing plates. Plates to be lined with length of foam glass insulation.

   a. 8" and smaller pipe: 12" long, 12 gauge plate
   b. 10" and larger pipe: 24" long, 10 gauge plate

3.8 FIELD QUALITY CONTROL

A. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.

END OF SECTION 22 07 00

SECTION 22 08 00 – COMMISSIONING OF PLUMBING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Division 1and 22 as set forth in these specifications are hereby incorporated into and shall become a part of the specifications for work under this section.

B. Owner furnished domestic booster pump, contractor installed equipment tested commissioned.

C. Related Sections.

1. Refer to Division 01 Section 019113 Commissioning Requirements for additional commissioning scope and requirements. All testing and commissioning requirements of that section shall be met.

1.2 CONTRACTOR'S RESPONSIBILITES

A. Perform commissioning tests at the direction of these specifications.

B. Attend construction phase controls coordination meetings.

C. Attend testing, adjusting and balancing review and coordination meeting.

D. Participate in plumbing systems, assemblies, equipment and component maintenance orientation and inspection as directed by these specifications.

E. Provide information requested by these specifications for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

G. Provide Project-specific construction checklists and commissioning process test procedures for actual Plumbing systems, assemblies, equipment and components to be furnished and installed as part of the construction contract.

H. Direct commissioning testing.

I. Verify contractor testing work is complete.

J. Provide test data, inspection reports and certificates in Systems Manual.

1.3 COMMISSIONING DOCUMENTATION

A. Provide the following information for inclusion in the Commissioning Plan:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for plumbing systems, assemblies, equipment and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks and startup procedures have been completed.
5. Certificate of readiness certifying that plumbing systems, subsystems, equipment and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.

1.4 SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart and startup activities.

PART 2 - PRODUCTS (Not used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Certify that plumbing systems, subsystems and equipment as part of the systems being commissioned have been installed, calibrated and started and are operating according to the Contract Documents.

B. Set systems, subsystems and equipment into operating mode to be tested (e.g., normal auto position, normal manual position, unoccupied cycle, emergency power and alarm conditions).

C. Inspect and verify the position of each device and interlock identified on checklists.

D. Check safety cutouts, alarms and interlocks with smoke control and life-safety systems during each mode of operation.

E. Testing Instrumentation: Install measuring instruments and logging devices to record test data.

3.2 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation and tools to perform commissioning test.

B. Scope of plumbing testing shall include plumbing systems as indicated below:

1. Plan to section 019113 for scope of plumbing systems testing and for equipment strategies and sampling requirement functional performance test requirements.

C. Test all operating modes, interlocks, control responses and responses to abnormal or emergency conditions.

D. The Plumbing Contractor shall prepare detailed testing plans, procedures and checklists for plumbing systems, subsystems and equipment to be commissioned.

E. Tests will be performed using design conditions whenever possible. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions.

F. Set points may be altered when simulating conditions is not practical.

G. Sensor values may be altered with a signal generator when design or simulating conditions and altering set points are not practical.

H. If tests cannot be completed because of a deficiency outside the scope of the plumbing system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

I. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.3 PLUMBING, SUBSYSTEM AND EQUIPMENT TESTING PROCEDURES

A. Plumbing Control System Testing: Field testing plans and testing requirements are specified by pump manufacturer and sequence of operations indicated in/or the construction documents.

B. Pipe system cleaning, flushing, hydrostatic tests and chemical treatment requirements are specified in Division 22 piping Sections. Plumbing Contractor shall prepare a pipe system cleaning, flushing and hydrostatic testing plan. Provide cleaning, flushing, testing and treating plan and final reports per this specification. Plan shall include the following:

1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
2. Description of equipment for flushing operations.
3. Minimum flushing water velocity.
4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

3.4 NON-CONFORMANCE

A. The results of the Functional Performance Tests. All deficiencies, non- conformance issues, or test failures will be noted and reported to the Contractors in a deficiency list or in a punch-list format.

B. Corrections of minor deficiencies identified may be made during the tests. In such cases the deficiency and resolution will be documented on the procedure form.

C. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures.

D. Re-testing:

1. If a Functional Performance Test fails, corrections shall be made to the deficient equipment or systems by the Contractor. The systems will be re-tested until they pass the tests.
2. Any required re-testing by any contractor, sub-contractor, or vendor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.

3.5 DEFICIENCES AND RE-TESTING

A. Document the results of each test. (Corrections of minor installation or sequence of operation deficiencies may be made during tests.)

B. Deficiencies/non-conformance issues not corrected during testing are reported to the Contractor for corrective action. Upon completion, a request is made by the Contractor for re-test.

END OF SECTION 22 08 00

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General Conditions, Special Conditions and Division 1 through Division 32 as set forth in these specifications are hereby incorporated into and shall become a part of the specifications for work under this section.

B. Provide a complete system of hot water and cold water to fixtures and equipment.

C. Make connection to kitchen equipment furnished and installed by the Kitchen Equipment Contractor.

D. Install and make connection to all faucets furnished by the case work manufacturer.

E. Make connection to all Owner furnished equipment.

F. Sterilize complete domestic water system.

G. See Section 221113 “Facility Water Distribution Piping” for site water-service piping outside the building from source to the point where water-service piping enters the building.

1.2 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing domestic water piping systems with 150 psi.

1.3 SUBMITTALS

A. Product Data: For pipe, tube, fittings and couplings.

B. Water Samples: Specified in Part 3 "Cleaning" Article.

C. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp or other markings of specified testing agency.

B. Comply with NSF 61, “Drinking Water System Components - Health Effects; Sections 1 through 9,” for potable domestic water piping and components.

C. Standards:

1. American National Standards Institute (ANSI)
2. American Society for Testing and Materials (ASTM)
3. American Water Works Association (AWWA)
4. National Sanitation Foundation (NSF)
5. Plumbing and Drainage Institute (PDI)

PART 2 - PRODUCTS

2.1 WATER PIPING, BURIED

A. Ductile Iron Pipe: AWWA C151, Class 55 cement lined. (Water Service only to 6" above interior floor and minimum of 5'-0" beyond the building foundation walls)

1. Manufacturer:

a. States Pipe and Foundry Company.
b. American
c. U.S. Pipe

2. Fittings: Ductile iron: AWWA C110/A21.10 cement lined, ASPH coated.
3. Joints: AWWA C111, rubber gasket with ¾ inch diameter rods. Rods only where the use of thrust blocks are not possible.

B. Copper Tubing: ASTM B88; or ASTM B251; Type K. (Exterior and interior underground)

1. Fittings: ASME B16, 18, cast copper alloy, or ASME B16.22, wrought copper and bronze, brazed joint, pressure type.
2. Joints: AWS A5.8 Classification BCuP-3 or BCuP-4 silver braze or ASTM B32.

C. PVC Pipe: AWWA C900, UL Listed, FM approved, Bell and Spigot. (Beyond 5 foot of building)

1. Manufacturer:

a. J-M Pipe Company, Inc.
b. Charlotte Pipe
c. U.S. Plastic
d. Central Pipe

2. Fittings: Ductile iron: AWWA C110/A21.10 cement lined, ASPH coated.
3. Joints: AWWA C111, rubber gasket with ¾ inch diameter rods. Rods only where the use of thrust blocks are not possible.

2.2 WATER PIPING, ABOVE GRADE

A. Copper Tubing: ASTM B88, Type L for sizes 4 inches and smaller.

1. Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper grooved or pro-press.
2. Joints: Solder, lead free, ASTM B32, 95-5 tin- antimony, or tin and silver, with melting range 430 to 435 degrees F.
3. Flanges: Bronze
4. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
5. Wrought-Copper Fittings: ASME B16.22. For hot and chilled water piping, Pro-Press fittings rated for 200 PSI operating pressure, 600 PSI test pressure and with 50 year warranty shall be permitted as an acceptable alternative for pipe sizes up to 4 inch system to be per ASTM B16.18 or ASTM B16.22 with EPDM O-rings.

B. Copper roll grooved: Pipe 2" and larger: (Not to be used in concealed spaces or pipe chases.)

1. Pipe: Copper Tubing: ASTM B88, type L, roll grooved.
2. Fittings: ASME B16.18, cast brass, or ASME B16.22, wrought copper roll grooved ends.
3. Joints: Grooved Ductile Iron Couplings
   Rigid Type: Conforming to ASTM A-395, key designed to clamp the bottom of the groove to provide rigidity. Gasket to be rated EPDM NSF G1 approved for hot and cold potable water.
   Flexible Type: Grooved Ductile Iron Couplings, conforming to ASTM A-395. Gasket to be rated EPDM NSF G1 approved for Fire Protection systems.
4. All products to be from one manufacturer and installed per manufacturer instructions.

2.3 FLANGES, UNIONS AND COUPLINGS

A. Pipe Size 2 Inches and Under:

1. Ferrous Pipe: 150 psig malleable iron threaded unions.
2. Copper tube and pipe: 150 psig bronze unions with soldered joints.

B. Pipe Size Over 2 Inches:

1. Ferrous Pipe: 150 psig forged steel slip-on flanges; 1/16 inch thick preformed neoprene gaskets.
2. Copper tube and pipe: 150 psig slip-on bronze flanges; 1/16 inch thick preformed neoprene gaskets.

C. Dielectric Connections: Flanges with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.4 GATE VALVES – 150 PSIG

A. Manufacturers:

1. William Powell: Models 1821, 1793
2. Other acceptable manufacturers offering equivalent products:

   a. Hammond IB635, IR1140
   b. Stockahm B-1-9, G-623
   c. Nibco S-111, F-617-ON
   d. Watts

B. Up to and including 2 inches: Bronze body, bronze trim, non-rising stem, handwheel, inside screw, single wedge or disc, solder or threaded ends.

C. Over 2 Inches: Iron body, bronze trim, rising stem, handwheel, OS & Y, plug-type disc, flanged ends, renewable seat and disc.

2.5 GLOBE VALVES – 150 PSIG

A. Manufacturers:

1. William Powell: Models 1823, 241
2. Other acceptable manufacturers offering equivalent products:

    a. Hammond IB423, IR 116
    b. Stockham B-24, G512
    c. Nibco IB-423, F718-B
    d. Watts B-4001-T, F501

B. Up to and including 2 inches: Bronze body, bronze trim, rising stem, handwheel, inside screw, renewable composition disc, solder or screwed ends, with back seating capacity.

C. Over 2 Inches: Iron body, bronze trim, rising stem, handwheel, OS & Y, plug-type disc, flanged ends, renewable seat and disc.

2.6 BALL VALVES – 150 PSIG

A. Bronze Manufacturers:

1. Watt Model B6001
2. Other acceptable manufacturers offering equivalent products:

    a. Hammond Model 8511
    b. Apollo Model 70-100/200
    c. Nibco 585

B. Up to and including 2 inches: Bronze two piece body, chrome plated brass or stainless ball, teflon seats and stuffing box ring, lever handle, solder or threaded ends with union.

C. Over 2 Inches: Cast steel body, chrome plated steel or stainless ball, Teflon seat and stuffing box seals, lever handle flanged.

D. PVC – Water System Only:

1. Manufacturer:

    a. Hayward
    b. Chemtrol
    c. Charlotte.

2. Double union PVC body ball valve. Teflon seats, Viton O-rings.

2.7 BUTTERFLY VALVES – 150 PSIG

A. Manufacturers:

1. Watt Model DBF03.
2. Other acceptable manufacturers offering equivalent products:

    a. Grinnell, LC-8201
    b. Keystone, AR2
    c. Hammond, 6201
    d. Centerline 200
    e. Demco NE-C

B. Cast or ductile iron body, chrome or nickel plated ductile iron disc, resilient replaceable EPDM seat, lug ends for dead end service, extended neck, 10 position level handle.

2.8 SWING CHECK VALVES – 150 PSIG

A. Manufacturers:

1. William Powell Model 560Y, 559
2. Other acceptable manufacturers offering equivalent products:

a. Hammond Model IB944, IR1124
b. Stockham Model B-321, G-931
c. Nibco Model S-433-B, F918-B
d. Watts B-5001T, F-511

B. Up to and including 2 inches: Bronze swing disc, solder ends.

C. Over 2 Inches: Iron body, bronze trim, swing disc, renewable disc and seat, flanged ends.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Excavating, trenching, and backfilling are specified in Division 31.

B. Flanges may be used on aboveground piping, unless otherwise indicated.

3.2 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use bronze ball valves for piping NPS 3 and smaller. Use cast-iron gate or butterfly valves with flanged ends for piping NPS 4 and larger.
2. Throttling Duty: Use balancing valves for piping NPS 2-1/2 and smaller.
3. Drain Duty: Hose-end drain valves.

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.

C. Install drain valves for equipment at base of water riser, at low points in horizontal piping and where required to drain water piping.

1. Install hose-end drain valves at low points in water mains, risers and branches.
2. Install stop-and-waste drain valves where indicated.

3.3 PIPING INSTALLATION

A. Provide piping materials as listed in part 2 of this specification section.

B. Install under-building-slab copper tubing according to CDA's "Copper Tube Handbook."

B. 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.

C. Install shutoff valve, hose-end drain valve, strainer and pressure gage inside the building at each domestic water service entrance. Install all valves in accessible locations. Coordinate installation of access panels.

D. Install domestic water piping level.

E. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

F. Where water lines drop in outside walls, install piping so that the wall insulation is between the pipe and the outside wall.

G. Coordinate installation height of faucets, hose bibbs, and wall hydrants and Owner's Representative.

H. Unless otherwise noted, install shock absorbers at the end of each main branch and at the end of all water closet and urinal branches.

I. Install dielectric unions between piping of dissimilar metals.

J. Install a union between valves and final connections to all items of equipment.

K. All soldering shall be done with propane torch. Oxy-Actylene is prohibited.

L. Nipples shall be of the material as the pipe with which they are used.

M. Install a check valve on all equipment with a hot and cold mixing valve.

N. Place plugs in ends of uncompleted piping at end of day and when work stops.

O. All pipes to be protected from debris entry.

3.4 JOINT CONSTRUCTION

A. 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. Open valves before soldering.

B. At the contractor's option: Piping NPS 4-inch and smaller. Type L drawn-temper copper tubing with Pro-press fittings or grooved mechanical joints for copper tube dimensions.

C. Joints for PEX Piping: Join according to ASTM F 1807.

3.5 HANGER AND SUPPORT INSTALLATION

A. Pipe hanger and support devices are specified in Division 230529 Section "Hangers and Supports for HVAC Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, and 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.

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.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one (1) size for double-rod hangers, to a minimum of 3/8".

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1.	NPS 3/4 and Smaller:	60" with 3/8" rod.
2.	NPS 1 and NPS 1-1/4:	72" with 3/8" rod.
3.	NPS 1-1/2 and NPS 2:	96" with 3/8" rod.
4.	NPS 2-1/2:	108" with 1/2" rod.
5.	NPS 3 to NPS 5:	120" with 1/2" rod.
6.	NPS 6:	120" with 3/4" rod.

E. Install supports for vertical copper tubing every 10'-0".

F. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:

1.	NPS 1” and Smaller:	36" with 3/8" rod.
2.	NPS 1-1/4 to NPS 2:	48" with 3/8" rod.
3.	NPS 2-1/2 to NPS 3 1/2:	48" with 1/2" rod.
4.	NPS 4 and NPS 5:	48" with 5/8" rod.
5.	NPS 6:	48" with 3/4" rod.
6.	NPS 8:	48" with 7/8" rod.

G. Install supports for vertical CPVC piping every 60 inches for NPS 1 and smaller and every 72 inches for NPS 1-1/4 and larger.

H. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1 and Smaller: 32 inches with 3/8 inch rod.

I. Install hangers for vertical PEX piping every 48 inches.

J. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1.	NPS 2” and Smaller:	48" with 3/8" rod.
2.	NPS 2-1/2 to NPS 3 1/2:	48" with 1/2" rod.
3.	NPS 4 and NPS 5:	48" with 5/8" rod.
4.	NPS 6:	48" with 3/4" rod.
5.	NPS 8:	48" with 7/8" rod.

3.6 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. Extend and connect to the following:

1. Water Heaters: Cold water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold and hot water supply piping in sizes indicated, but not smaller than required by plumbing code.
3. Equipment: Cold and hot water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.7 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:

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 24 hours 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 test or inspection, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic water piping as follows:

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. If testing is performed in segments, submit separate report for each test complete with diagram of portion of piping tested.
3. Leave 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 150 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four (4) hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.8 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. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.

6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
7. Check plumbing specialties and verify proper settings, adjustments and operation.

3.9 STERILIZATION OF WATER LINES

A. After water piping is complete and fixtures have been installed, flush piping clean and sterilize all new hot and cold water piping. The sterilization shall be done by a Water Testing Laboratory regularly engaged in the service. All fees for testing and use of testing equipment shall be paid by this Contractor.

B. With all outlets closed, fill system to working pressure and close valve on supply main.

C. Open all fixtures slightly and pump a sterilization solution into test tap as follows; 400 minimum to 1000 maximum parts per million chlorine solution made from a sanitation grade of hyperchlorite, 70% available chlorine. Hyperchlorites may be either Pittchlor, H.T.H. or Perclorn.

D. Each outlet, hot or cold, shall be tested during fill to prove the presence of chlorine at that outlet and shall be opened and closed several times. Chlorine shall be present at all outlets.

E. Water piping system shall remain filled for a period of 24 hours and each outlet shall be again tested and shall have at least 100 parts per million of chlorine remaining.

F. All outlets shall be opened wide and the main supply valves opened, flushing system free of chlorine with clean water. Outlets shall be again checked and flushed until free of chlorine. Residual chlorine shall not be greater than 0.2 parts per million or until approved by the State Health Department. Flush main valves and entire system.

G. After final flushing, all aerators shall be removed, cleaned and replaced.

H. Chlorination of the system may be performed at same time the pressure test is conducted.

I. Sterilization procedures shall be witnessed by the Architect, city and health officials and the Owner's Representative.

J. After sterilization of system is complete, provide the Owner with written certification from an outside testing agency certified in this manner of testing of sterility and confirmation that piping is clean and safe to transmit water fro human consumption.

END OF SECTION 22 11 16

SECTION 22 13 13 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide a complete sanitary sewer, including manholes, outside the building as indicated on the drawings.

1.2 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:

1. Soil, Waste and Vent Piping: 10-foot head of water.

1.3 SUBMITTALS

A. Product Data: For pipe, tube, fittings and couplings.

1.4 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.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic pipe and fittings in direct sunlight.

B. Protect pipe, pipe fittings and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Sewerage 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 two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Owner's Representative written permission.

PART 2 - PRODUCTS

2.1 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS EXTERIOR TO THE BUILDING (As approved by sewer department.)

A. Pipe and Fittings: ASTM A 74, Service class.

B. Fittings: Cast iron.

C. Gaskets: ASTM C 564, rubber.

D. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

E. Joints: ASTM C564, neoprene gasket system. Joints bonded with Gilman adhesive lubricant.

2.2 DUCTILE-IRON, GRAVITY SEWER PIPE AND FITTINGS

A. Pipe: ASTM A 746, for push-on joints.

B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.

C. Compact Fittings: AWWA C153, ductile iron, for push-on joints.

D. Gaskets: AWWA C111, rubber.

2.3 PVC PIPE AND FITTINGS

A. PVC Sewer Piping:

1. Pipe: ASTM D 3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

2.4 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76.

1. Bell-and-spigot ends for gasketed joints, with ASTM C 443, rubber gaskets.

2.5 CLEANOUTS

A. Cast-Iron Cleanouts:

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

a. Josam Company.
b. MIFAB, Inc.

c. Smith, Jay R. Mfg. Co.
d. Tyler Pipe.
e. Watts Water Technologies, Inc.
f. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

2. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
3. Top-Loading Classification(s): Heavy Duty.
4. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling as specified in other sections of these specifications.

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grade and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves and couplings according to manufacturer's written instructions for using lubricants, cements and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of micro tunneling.

F. Install gravity-flow, non-pressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow at minimum slope of 1 percent, unless otherwise indicated.
2. Install piping with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system or cast-in-place-concrete supports or anchors.
3. Install piping with 30 inch minimum cover.
4. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
5. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."

6. Install ductile-iron, gravity sewer piping according to ASTM A 746.
7. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

G. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.4 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use heavy-duty, top-loading classification cleanouts in all areas.

3.5 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place and again at completion of Project.

1. Submit separate report for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Damage: Crushed, broken, cracked or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Infiltration: Water leakage from or around piping.

3. Replace defective piping using new materials and repeat inspections until defects are within allowances specified.
4. Re-inspect and repeat procedure until results are satisfactory.

B. Test new piping systems and parts of existing systems that have been altered, extended or repaired for leaks and defects.

1. Do not enclose, cover or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

a. Fill sewer piping with water. Test with pressure of at least 10-foot head of water and maintain such pressure without leakage for at least 15 minutes.
b. Close openings in system and fill with water.
c. Purge air and refill with water.
d. Disconnect water supply.
e. Test and inspect joints for leaks.

6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6 and the following:

a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
b. Option: Test concrete gravity sewer piping according to ASTM C 924.

7. Force Main: Perform hydrostatic test after thrust blocks, supports and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure but not less than 150 psig.

a. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials and repeat testing until leakage is within allowances specified.

3.6 CLEANING

A. Clean dirt and superfluous material from interior of piping.

END OF SECTION 22 13 13

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SECTION 22 13 16 – SANITARY WASTE VENT SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide a complete system of soil, waste and vent piping to fixtures and equipment including traps, floor drains and cleanouts within the building.

1.2 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:

1. Soil, Waste and Vent Piping: 10-foot head of water.

1.3 SUBMITTALS

A. Product Data: For pipe, tube, fittings and couplings.

1.4 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.

PART 2 - PRODUCTS

2.1 SANITARY SEWER PIPING, BELOW GRADE OR SLAB

A. Cast Iron Hub and Spigot Pipe and Fittings: ASTM A74 service weight.

1. Fittings: Cast iron.
2. Joints: ASTM C564, neoprene gasket system.
3. Joints bonded with Gilman adhesive lubricant and anchored per CISPI 1994.

B. Copper Tube: ASTM B88, Type L.

1. Fittings: ASME B16.23, cast bronze, or ASME B16.29, wrought copper.
2. Joints: ASTM B32, solder, Grade 50B.
   Gaskets: ASTM F 477, elastomeric seals.

C. PVC Piping

1. Pipe: Schedule 40, ASTM D 2665, solid-wall drain, waste, and vent.
2. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain patterns.
3. Solvent joints per ASTM D 2665.

D. PVC Pipe and Fittings:
(Not approved on any kitchen waste / sanitary system in the kitchen due to higher temperature of discharge waste to the piping system)

1. PVC Sewer Piping:
   Pipe: ASTM D 3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.

Fittings: ASTM D 3034, PVC with bell ends.

2.2 SANITARY SEWER, ABOVE GRADE

A. Cast Iron Pipe: ASTM A74 service weight

1. Fittings: Cast iron.
2. Joints: ASTM C564, neoprene gasket system.
3. Joints bonded with Gilman adhesive lubricant and anchored per CISPI 1994.

B. Cast Iron Pipe: CISPI 301, hubless, service weight.

1. Fittings: Cast iron.
2. Joints: Neoprene gaskets and 304 stainless steel clamp-and wide shield assemblies. Joints bonded with Gilman adhesive lubricant and rodded per CISPI 1994.

C. Copper Tubing

1. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

a. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

D. PVC Piping: (To be used on all urinal waste piping to main in chases and walls only and as approved by the contract bid documents for all other systems; not approved on any kitchen waste / sanitary system in the kitchen due to higher temperature of discharge waste to the piping system)

1. PVC Pipe: Schedule 40, ASTM D 2665, solid-wall drain, waste and vent.

a. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste and vent patterns.
b. Solvent joints per ASTM D 2665.

2.3 FORCE MAIN

A. Copper Tubing: ASTM B88, Type L hard drawn.

1. Fittings: ASME B16.18, cast bronze, or ASME B16.22, wrought copper and bronze.
2. Joints: ASTM B32, solder, grade 50B.

2.4 POLYETHYLENE PIPE (Beyond 5'-0" of the building)

A. High density polyethylene.

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the f following:

a. J-M Pipe Company, Inc.
b. Charlotte Pipe
c. U.S. Plastic
d. Central Pipe

2. AWWA C901 approved.
3. Electrofusion fittings.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 2 for excavating, trenching and backfilling.

3.2 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

B. Sanitary soil, waste and vents:

1. Underground soil and waste inside the building:

a. Pipe: Service weight cast iron no-hub pipe with heavy duty stainless steel couplings
b. Fittings: Cast iron to match pipe

3.3 PIPING INSTALLATION

A. Provide piping materials as listed in part 2 of this specification section.

B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

C. 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.

D. 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."

E. 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 (2) 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□. 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.

F. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment, indicate 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.

G. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 2% downward in direction of flow for piping NPS 3 and smaller; 1% downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Drainage Piping: 2% downward in direction of flow.
3. Vent Piping: 1% down toward vertical fixture vent or toward vent stack.

H. Minimum size for underground soil, waste and vent piping is 2".

I. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

J. Do not enclose, cover or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
2. Hubless Joints: Make with rubber gasket and sleeve or clamp.

B. 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.

C. Solvent Cement and Adhesive Primer:

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. 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).

3.5 HANGER AND SUPPORT INSTALLATION

A. Refer to Division 220529 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. 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.

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.

B. Support vertical piping at base and at each floor.

C. Rod diameter may be reduced one (1) size for double-rod hangers, with 3/8" minimum rods.

D. 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" with 3/8" rod.
2. NPS 3: 60" with 1/2" rod.
3. NPS 4 and NPS 5: 60" with 5/8" rod.
4. NPS 6: 60" with 3/4" rod.
5. Spacing for fittings is limited to 60".

E. Install supports for vertical cast-iron soil piping every 15'-0".

F. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72" with 3/8" rod.

G. Install supports for vertical copper tubing every 10'-0".

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 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.

3.7 VENTS

A. INSTALL VENTS THROUGH ROOF AS FOLLOWS

1. 3" minimum size and extended a minimum of 12" above the roof.
2. Locate at least 8'-0" away from outside wall of building, 15'-0" away from outside air intakes or operable windows, and 2'-0" away from roof flashing work.
3. Offset vent piping to allow for thermal expansion and contraction.
4. Vent flashing to extend at least 12" from vent pipe, clamp between roofing and extend up, over and turn down inside vent pipe.

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 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 drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1" wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 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 22 13 16

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SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Cleanouts.
   2. Floor drains.
   3. Grease 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. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
   1. Grease interceptors.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:
1. ASME A112.36.2M, Cast-Iron Cleanouts:
   a. Jay R. Smith Mfg. Co.
   b. Watts
   c. Zurn Plumbing Products Group
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 as required to match connected piping.
5. Closure: Raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:
   a. Jay R. Smith Mfg. Co.
   b. Watts
   c. Zurn Plumbing Products Group
2. Standard: ASME A112.36.2M for cast-iron soil pipe with cast-iron ferrule cleanout.
3. Size: Same as connected branch.
4. Type: Cast-iron soil pipe with cast-iron ferrule.
5. Body or Ferrule: Cast iron.
6. Adjustable Housing Material: Cast iron.
7. Frame and Cover Material and Finish: Polished bronze.
8. Frame and Cover Shape: Round.
9. Top Loading Classification: Heavy Duty.
10. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
11. Standard: ASME A112.3.1.
12. Size: Same as connected branch.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains
1. Manufacturers:
   a. Jay R. Smith Mfg. Co.
   b. Watts
   c. Zurn Plumbing Products Group
2. Standard: ASME A112.6.3.
3. Body Material: Gray iron.
4. Anchor Flange: Required.

5. Clamping Device: Required.
6. Outlet: Bottom.
7. Coating on Interior and Exposed Exterior Surfaces: Not required.
8. Top or Strainer Material: Bronze.
9. Top of Body and Strainer Finish: Polished bronze.
10. Top Shape: Round.
11. Top Loading Classification: Heavy Duty.
12. Funnel: Not required.
13. Trap Material: Cast iron.
14. Trap Pattern: Standard P-trap.
15. Trap Features: Not required.

2.3 GREASE INTERCEPTORS

A. Grease Interceptors:
   1. Relocate existing grease interceptor as indicated on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate at base of each vertical soil and waste stack.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Install 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.

E. Assemble and install ASME A112.3.1, stainless-steel channel drainage systems according to ASME A112.3.1. Install on support devices so that top will be flush with surface.

F. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
   1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
   2. Size: Same as floor drain inlet.

H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

I. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

J. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

K. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Grease interceptors.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

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 22 13 19

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SECTION 22 14 13 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The General Conditions, Special Conditions and Division 1 through Division 32 as set forth in these specifications are hereby incorporated into and shall become a part of the specifications for work under this project.

1.2 SUMMARY

A. This Section includes the following storm drainage piping outside the building:

1. Pipe, tube and 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. Provide components and installation capable of producing piping systems with the following minimum working pressure ratings, unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings and couplings.

B. 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.

C. Standard: State Environmental Protection Agency

PART 2 - PRODUCTS

2.1 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

D. Fittings: Cast iron.

E. Joints bonded with Gilman adhesive lubricant and anchored per CISPI 1994.

2.2 FORCE MAIN (Sump Pump Discharge)

A. Cooper Tubing: ASTM B88, Type L hard drawn.

1. Fittings: ASME B16.18, cast bronze, or ASME B16.22, wrought copper and bronze.
2. Joints: ASTM B32, solder, grade 50B.

2.3 PVC PIPE AND FITTINGS

A. PVC Sewer Piping:

1. Pipe: ASTM D 3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

2.4 CORRUGATED HIGH DENSITY PIPE WITH SMOOTH WATERWAY

A. Corrugated high density pipe with smooth waterway: ADS N12 or Hancor HI-Q

1. Fittings: Molded or fabricated to match pipe.
2. Joints: Neoprene gasketed couplings.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 31 for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Provide piping materials as listed in part 2 of this specification section.

B. Excavating, trenching, and backfilling as specified in other sections of this specifications.

C. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

D. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves and couplings according to manufacturer's written instructions for using lubricants, cements and other installation requirements.

E. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

F. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

G. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

H. Install gravity-flow, non-pressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
2. Install piping with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
3. Install piping with 30 inch minimum cover.
4. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
5. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
6. Install ductile-iron, gravity sewer piping according to ASTM A 746.
7. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

I. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

J. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

K. 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.

L. 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.

M. 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.

N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves: Install shutoff valve on containment pad drainage system.

1. Install gate valve for piping NPS 4 and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sump pump discharge.

3.4 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 force-main piping to the following:

1. Storm Sewer: To branch provided by site utility contractor.
2. Sump Pumps: To area or catch basin.

3.5 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 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. 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.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.6 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 22 14 13

SECTION 22 14 23 - STORM SEWER SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General Conditions, Special Conditions and Division 1 through Division 32 as set forth in these specifications are hereby incorporated into and shall become a part of the specifications for work under this project.

1.2 SUMMARY

A. SCOPE OF WORK

1. Provide all storm drainage piping system for interior of the building.

1.3 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with the following minimum working pressure ratings, unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

1.4 SUBMITTALS

A. Product Data: For pipe, tube, fittings and couplings.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Standard: State Environmental Protection Agency.

PART 2 - PRODUCTS

2.1 STORM WATER PIPING, BURIED INTERIOR OF BUILDING

A. Cast Iron Pipe: ASTM A74 service weight

1. Fittings: Cast iron.
2. Joints: ASTM C564, neoprene gasket system.
   Joints bonded with Gilman adhesive lubricant and anchored per CISPI 1994.

B. Copper Tube: ASTM B88, Type L

1. Fittings: ASME B16.23, cast bronze, or ASME B16.29, wrought copper.

2. Joints: ASTM B32, solder, Grade 50B.

C. Grooved End Piping:

1. Pipe: Schedule 40 galvanized.
2. Fittings: Galvanized grooved end.
3. Couplings: Grooved with EPDM gaskets.

D. PVC Piping

1. PVC Pipe: Schedule 40, ASTM D 2665, solid-wall drain, waste, and vent.

a. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain patterns.
b. Solvent joints per ASTM D 2665.

2.2 STORM WATER PIPING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A74 service weight

1. Fittings: Cast iron.
2. Joints: ASTM C564, neoprene gasket system.
Joints bonded with Gilman adhesive lubricant and anchored per CISPI 1994.

B. Cast Iron Pipe: CISPI 301, hubless, service weight.

1. Fittings: Cast iron.
2. Joints: Neoprene gaskets and 304 stainless steel clamp-and wide shield assemblies. Joints bonded with Gilman adhesive lubricant and rodded per CISPI 1994.

C. Copper Tube: ASTM B88, Type L

1. Fittings: ASME B16.23, cast bronze, or ASME B16.29, wrought copper.
2. Joints: ASTM B32, solder, Grade 50B.

D. Grooved End Piping:

1. Pipe: Schedule 40 galvanized.
2. Fittings: Galvanized grooved end.
3. Couplings: Grooved with EPDM gaskets.

E. PVC PIPING (To be used only and as approved by the contract bid documents)

1. PVC Pipe: Schedule 40, ASTM D 2665, solid-wall drain, waste, and vent.

a. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain patterns.
b. Solvent joints per ASTM D 2665.

2.3 FOOTING DRAIN TILE

A. Extra strength Bell and Spigot perforated vitrified tile.

1. Fittings: Vitrified clay.
2. Joints: Bell & Spigot.
3. Pipe Cover: Encase pipe in fabric sock equivalent to Big-O-Soc, density weight of 5.4 oz/yd.

B. ADS or Hancor corrugated polyethylene ODOT approved ASSHTO M252 perforated piping. Bedding per manufacturer requirements.

1. Fittings: To match pipe materials.
2. Joints: Bell & Spigot.
3. Pipe Cover: Encase pipe in fabric sock equivalent to Big-O-Soc, density weight of 5.4 oz/yd.

2.4 FORCE MAIN

A. Cooper Tubing: ASTM B88, Type L hard drawn.

1. Fittings: ASME B16.18, cast bronze, or ASME B16.22, wrought copper and bronze.
2. Joints: ASTM B32, solder, grade 50B.

2.5 POLYETHYLENE PIPE (Beyond 5'-0" of the building)

A. High density polyethylene.

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

a. J-M Pipe Company, Inc.
b. Charlotte Pipe
c. U.S. Plastic
d. Central Pipe

2. AWWA C901 approved.
3. Electrofusion fittings.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 31 for excavating, trenching and backfilling.

3.2 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

3.3 PIPING INSTALLATION

A. Provide piping materials as listed in part 2 of this specification section.

B. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers.

C. 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.

D. 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."

E. Make changes in direction for storm 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.

F. Lay buried building drain 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.

G. 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.
2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

H. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

I. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings" and manufacturer's recommendations."

1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
2. Hubless joints: Make with rubber gasket and sleeve or clamp.
3. Grooved End: To be assembled per manufacturer’s instructions.

B. Solvent Cement and Adhesive Primer:
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. 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).

3.5 HANGER AND SUPPORT INSTALLATION

A. Refer to Division 23 Section 230529 "Hangers and Supports for HVAC Piping and Equipment." 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.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

D. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1.	NPS 1-1/2 and NPS:	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.

E. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 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. Extend storm drainage piping with downspout boots from each downspout, as indicated on drawings.

3.7 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 piping. 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, 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 except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10 foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. 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.

3.8 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses. Flush lines as required to remove collected debris.

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 22 14 13

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SECTION 22 40 00 – PLUMBING FIXTURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General Conditions, Special Conditions and Division 1 through Division 32 as set forth in these specifications are hereby incorporated into and shall become a part of the specifications for work under this section.

B. Provide plumbing piping specialties or accessories as required by either the equipment manufacturer or the Local Code Authority.

C. Provide plumbing fixtures as indicated on the Drawing and Schedules.

D. Provide trim, fittings, carriers, stops and all accessories required for a complete installation.

1.2 DEFINITIONS

A. ADA Accessible Fixture: Plumbing fixture that can be approached, entered and used by people with disabilities.

B. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

C. Tepid: Approximately 85°F temperature with an allowable variation of +/- 5°F.

1.3 SUBMITTALS

A. Submit per the provisions of Section 220500.

B. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.

C. Shop Drawings: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

D. Maintenance Data: For plumbing fixtures to include in maintenance manuals specified in section 220500.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets and other components of each category through one (1) 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. Select combinations of fixtures and trim, faucets, fittings and other components that are compatible.

D. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
2. Hand Sinks: NSF 2 construction.
3. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
4. Slip-Resistant Bathing Surfaces: ASTM F 462.
5. Stainless-Steel Fixtures Other Than Service Sinks: ASME A112.19.3M.
6. Vitreous-China Fixtures: ASME A112.19.2M.
7. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.

E. 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. Faucet Hose: ASTM D 3901.
5. Faucets: ASME A112.18.1M.
6. Hose-Connection Vacuum Breakers: ASSE 1011.
7. Hose-Coupling Threads: ASME B1.20.7.
8. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
9. NSF Materials: NSF 61.
10. Pipe Threads: ASME B1.20.1.
11. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
12. Supply and Drain Fittings: ASME A112.18.1M.

F. 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 A112.18.1M.
3. Plastic Tubular Fittings and Piping: ASTM F 409.
4. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
5. Tubular Brass Drainage Fittings and Piping: ASME A112.18.1M.

G. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Disposers: ASSE 1008 and UL 430.
2. Floor Drains: ASME A112.21.1M.
3. Hose-Coupling Threads: ASME B1.20.7.
4. Off-Floor Fixture Supports: ASME A112.6.1M.
5. Pipe Threads: ASME B1.20.1.
6. Plastic Toilet Seats: ANSI Z124.5.
7. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES AND ACCESSORIES

A. Owner Furnished Equipment

1. See schedules on the drawing for fixtures and accessories provided by the Owner and installed under this contract. This contract to include all components and accessories as indicated on the schedules.

B. KITCHEN EQUIPMENT CONTRACTOR FURNISHED EQUIPMENT

1. See Kitchen construction documents for kitchen equipment furnished and/or installed by the Kitchen Equipment Contractor.

2. Plumbing Contractor shall install all required kitchen fixtures and provide all CW, HW, waste and vent piping and all shut off valves, accessories, etc. associated with connections to kitchen equipment similar to those specified and scheduled for plumbing fixtures.

C. PLUMBING CONTRACTOR FURNISHED FIXTURES

See schedules on the drawings per the following:

1. DISPOSAL

   a. Unit complete with capacitor start motor suitable for single phase 120 volt electric supply rated not more than 7.6 amperes, permanently lubricated upper and lower bearings, UL listed, tailpiece, overload protection, sound absorbing steel, stainless stopper and 5 full years parts and service warranty, dishwasher connection.

2. ELECTRIC WATER COOLER:

   a. Frame: Galvanized steel chassis to support fountain top and all working mechanisms. No operating parts connected to cabinet panels. Cabinet to be mounted flush to wall. Front and side panels shall be removable. Basin shall be stainless steel. Cabinet color to be standard color as selected by Architect. Cabinet to be installed on wall bracket.

   b. Fountain Top: One (1) piece stainless steel polished to a bright luster finish. Basin shall have integral drain grid and embossed bubbler pad.

   c. Bubbler: Built in flow regulator to provide a constant stream between 20 to 105 psi water pressure. Orifice to be designed to prevent accidental mouth injuries, anti sweat, non squirt and protected to meet all sanitary codes.

   d. Push Bars: Light touch activation with front push bar with textured finish.

   e. System: Waterway shall have copper components and completely lead free materials. All joints to be brazed with silver solder. A strainer with easily cleanable screen capable of filtering 140 microns or larger particles shall be provided.

   f. Compressor: 115VAC, 60hz, single phase hermetically sealed compressor with electric plug cord.

   g. Condenser: Fan cooled, copper tube with aluminum fins. Fan motor to be permanently lubricated. Refrigerant shall be HFC-134a.

   h. Temperature control: Enclosed, easily accessible, adjustable, factory set, thermostat with off position.

   i. Cooling Unit: Combination tube-tank type. Tube portion is continuous coil of copper tubing. Tank is copper and fully insulated with polyurethane foam.

   j. Standards: Unit shall be UL listed and shall comply with ARI standard.

   k. Warranty: Refrigeration system to be warranted for five (5) years

   l. Capacity: See schedule on drawings.

3. STAINLESS STEEL SINK:

   a. Interior surfaces to be polished with highlighted bowl rim. Underside to be fully coated. Sink to conform to ASME/ANSI A112.19.3M.

b. Stainless steel drain with chrome plated brass tailpiece.
c. Faucet shall be 8" center concealed deck faucet with polished chrome plate finish, swing neck spout, aerator. Provide an ASSE thermostatic mixing valve on each faucet below the bowl.
d. Furnish and install drain connections with rubber stoppers. Provide and install chrome plated p-trap with cleanout plug and accessories.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Use manufacturer's roughing-in data if roughing-in data is not indicated.

B. Examine walls, floors and cabinets for suitable conditions where fixtures are to be installed.

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

3.2 FIXTURE INSTALLATION

A. Assemble fixtures, trim, fittings and other components according to manufacturers' written instructions.

B. For wall-hanging fixtures, install off-floor supports affixed to building substrate.

C. Install counter-mounting fixtures in and attached to casework.

D. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.

E. 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. Exceptions: Omit shutoff valve to emergency equipment.

F. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

G. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

H. 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.

I. Install water-supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.

J. Install shower, flow-control fittings with specified maximum flow rates in shower arms.

K. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

L. Install chrome plated brass escutcheons at piping wall or ceiling penetrations in exposed,

finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings.

M. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Division 7 Section "Joint Sealants" for sealant and installation requirements.

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings and specialties.

B. Connect water supplies from water distribution piping to fixtures.

C. Connect drain piping from fixtures to drainage piping.

D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.

E. Ground equipment.

1. 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.

3.4 FIELD QUALITY CONTROL

A. Verify that installed fixtures are categories and types specified for locations where installed.

B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 MOUNTING HEIGHTS

A. Fixtures to be mounted at the following heights or according to manufacturer's recommendations, unless noted or directed otherwise.

1. Regular Mounting Heights:
See Architectural drawings and sections for fixture mounting heights.

2. Handicapped Mounting Heights:
See Architectural drawings and sections for fixture mounting heights.

3.6 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets, shower valves, and flushometer valves to produce proper flow and stream.

C. Replace washers and seals of leaking and dripping faucets and stops.

D. Adjust equipment temperature settings.

3.7 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.

3.8 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 40 00

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SECTION 23 00 00 - HEATING, VENTILATING, AND AIR CONDITIONING WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes a summary of all Heating, Ventilating, and Air Conditioning related work.

B. Related Sections:
1. 23 04 00 – GENERAL HEATING, VENTILATING, AND AIR CONDITIONING (HVAC) REQUIREMENTS
2. 23 05 00 – COMMON WORK RESULTS FOR HVAC
3. 23 05 13 – COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
4. 23 05 19 – PIPING SPECIALTIES FOR HVAC PIPING
5. 23 05 23 – GENERAL-DUTY VALVES FOR HVAC PIPING
6. 23 05 29 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
7. 23 05 48 – VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT
8. 23 05 53 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
9. 23 05 93 – TESTING, ADJUSTING, AND BALANCING FOR HVAC
10. 23 07 00 – HVAC INSULATION
11. 23 08 00 – COMMISSIONING OF HVAC
12. 23 11 23 – NATURAL GAS PIPING
13. 23 21 11 – PIPING MATERIALS
14. 23 21 13 – HYDRONIC PIPING
15. 23 21 14 – HOT WATER HEATING SYSTEM
16. 23 21 15 – CHILLED WATER SYSTEM
17. 23 25 00 – HVAC WATER TREATMENT
18. 23 31 13 – METAL DUCTS
19. 23 34 16 – CENTRIFUGAL HVAC FAN
20. 23 37 13 – DIFFUSERS, REGISTERS, AND GRILLES
21. 23 37 14 – LOUVERS
22. 23 73 13 – MODULAR INDOOR CENTRLA STATION AIR HANDLING UNIT
23. 23 73 14 – VARIABLE-FREQUENCY MOTOR CONTROLLERS

1.3 PROJECT CONDITIONS

A. Alterations of and Additions to Existing HVAC Systems:
1. The contract shall include the installation of the work as shown, specified, or required and shall include, but not limited to, the following principal components:
   a. Furnish and install new air handling unit.
   b. Provide new equipment pads for all new equipment.
   c. Provide certain new pipe and equipment insulation.
   d. Repair any existing insulation damaged in the course of this work.
   e. Provide automatic temperature controls for new systems.
   f. Provide new instruments as shown.
   g. Provide requisite drain piping.
   h. Extend chilled water piping as indicated.
   i. Provide requisite drain and flushing connections for testing and chemical treatment.
   j. Perform final setting and leveling of all new equipment.
   k. Provide variable frequency drives for installation by Electric Contractor.
   l. Provide certain new ductwork, grilles, diffusers, etc.
   m. Provide certain duct insulation.
   n. Provide all required air and water balancing.
   o. Perform start-up for all HVAC systems and commission same in accordance with the commissioning requirement.
   p. Provide and/or participate in training of Owner's personnel on the use of all new HVAC systems.
   q. Attend weekly job meetings and prepare meeting notes.
2. Refer to drawings for Schedules of HVAC Equipment.
3. The contractor shall exercise adequate protective and safety measures for all persons and property and shall be responsible for any damages or injuries arising from the execution of this work.
4. Alterations and additions to existing work shall include the requisite dismantling of the old equipment, rigging, wrecking, hauling, protections of permanent equipment and the building structures, and cleaning up. Care shall be exercised to keep dust and dirt to a minimum and to confine it to the area where the removal work is being performed. All debris shall be promptly removed.
5. If asbestos insulation is encountered on any existing piping which is to be removed or remodeled, contractor shall immediately notify Owner of the existence of asbestos and Owner will arrange proper removal of same without cost to contractor.
6. Unless otherwise noted, remove all other existing equipment and piping, valves, fittings, etc. which will not be reused in the final arrangement. Unless otherwise noted, all items which will be removed by this this contractor and not reused shall become the property of the contractor and shall be promptly removed from the site by him.
7. The existing campus will be occupied and will remain in operation throughout the period that this work is being performed, and certain new work will be performed during this period. Unscheduled interruptions of the campus will not be tolerated. The contractor shall exercise extreme caution, shall thoroughly inform his workmen and subcontractors of the critical nature of this work, and shall continually review the work procedure being followed in order to prevent accidental interruption of service. Before performing any act which could result in interruption of service, the contractor shall notify the Owner and Engineer of the hazards involved and the contractor shall proceed in a manner and at a time specifically approved by the Owner and Engineer.
8. All work necessitating the temporary turning off or shutting down the operation of existing mechanical and/or electrical facilities shall be done at times specifically approved by the Owner and Engineer in advance of any disruption of existing facilities. Also, refer to Section 23 04 00 – General Heating, Ventilating, and Air Conditioning (HVAC) Requirements.

B. Demolition Work
1. Remove all equipment not used in the final arrangement shown on the drawings including all piping, hangers, supports, accessories, concrete pads, insulation, etc.
2. Coordinate all Demolition with the owner sot that shutdowns occur at times agreeable to the Owner.
3. Coordinate chilled water shutdowns with the Owner and demo piping as required.

C. Guarantee
1. The HVAC equipment will be guaranteed as specified in the specific equipment specifications. This contractor shall guarantee all other workmanship, materials, and equipment entering into this contract for a period of two years; all from date of substantial completion or from the "recognized" start-up date, whichever is later. Should the Owner elect to accept a portion of work prior to the date of substantial completion, the guarantee period for the accepted portion of the work shall commence on the date of acceptance or on the "recognized" start-up date for that portion of the work, whichever is later. If the specifications dictate a different period of guarantee for a given component or piece of equipment, the more stringent requirements shall govern.
2. The "recognized" start-up date shall be defined as that date on which the contractor has successfully completed all phases of his work, including the following:
   a. Submitted and received approval of four (4) copies of the Instruction Booklets.
   b. Submitted complete "As-Built" drawings.
   c. Completed all testing, cleaning, adjusting, and trial run.
   d. Completed all training of Owner's personnel.
3. In the case where the Engineer is accepting a portion of the work, the contractor shall have completed all phases of that portion of the work to be accepted, including Items above, for that accepted portion of the work.
4. Any workmanship, materials, or equipment proving to be defective during this guarantee period shall be made good by this contractor without additional cost to the Owner.
5. Refer to Division 00.

D. Equipment
1. Any and all costs associated with piping, electric, wiring, conduit, supports, pads, or other modifications to accommodate installation for manufacturer's equipment that differs from equipment layout on drawings shall be included on contractor's bid. The contractor is responsible to insure that the equipment will fit within space allocated with appropriate clearances for maintenance, operation, servicing, and code.

E. Schedule
1. The contractor shall be responsible to meet the project schedule as stated by the Owner. The contractor shall include in his bid the cost associated with all requisite coordination.
2. In addition, the contractor must prepare a schedule for his work that integrates with the Owner's schedule. The contractor shall update progress and revise schedule at least twice monthly.
3. This contractor shall be responsible to expedite any materials and work any overtime in order to meet the schedule. The cost for any expediting of overtime work shall be included in his bid.

1.4 DUKE ENERGY INCENTIVE PROGRAM

A. Comply with all requirements of the Duke Energy Incentive Program in order that the Owner will be able to obtain incentive monies from Duke Energy for this project. If Duke Energy requirements are more restrictive than the specifications, the Duke Energy requirements shall govern. A copy of the Duke Energy Incentive information for equipment is available on their web site. The contractor shall complete these forms, provide all requisite documentation, and present this information to the Owner for submission to Duke Energy. The incentive monies shall be solely available to the Owner.

1.5 LEED REQUIREMENTS

A. While it is the intent of the Owner to design and construct a highly sustainable building with the integration of many LEED and Green building techniques, this building will not be LEED Certified.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 23 00 00

SECTION 23 04 00 - GENERAL HEATING, VENTILATING, AND AIR CONDITIONING (HVAC) REQUIREMENTS

PART 1 - GENERAL

1.1 HVAC WORK

A. The following paragraphs are applicable to Division 23 and are complementary to other sections of specifications. Where items described in other sections of the specifications are repeated herein, it is done to call special attention to or to qualify them, but it is not intended that any part of the documents shall be assumed to be omitted if not repeated herein.

B. Where contradictions occur between this section and Division 1, the most stringent of the two shall apply. Architect/Engineer shall decide which is most stringent.

1.2 DRAWINGS AND SPECIFICATIONS

A. HVAC drawings are diagrammatic and indicate general arrangement of systems and work included in the contract and shall be adhered to insofar as possible. The drawings and specifications are complementary and are intended, without giving every minute detail, to cover a workable installation complete in every respect including, whether mentioned or not, all material and equipment usually furnished with such systems and/or needed to make a complete operational installation omitting only such parts as are specifically excepted.

B. Consult drawings and details for exact location of fixtures and equipment, and where not definitely indicated, request this information in writing.

C. The specification for each division of the work is written in sectional form for brevity and convenience in reference, without repeating in each section all applicable general clauses and/or pertinent data covered elsewhere in the specification, but it is not intended that any of the documents shall be assumed to be omitted if not repeated in each division.

D. Where specifications are written for brevity, with incomplete sentences, the omission of words or phrases, such as "the contractor shall", "shall be", "provide", "furnish", "all", etc. are intentional and such omitted words or phrases shall be supplied by inference; unless otherwise mentioned, such clauses, lists, and/or directives indicate work to be done by the contractor for that specific division of work.

1.3 LAWS AND ORDINANCES

A. Contractors who perform any work under this contract shall fully comply with the provisions of the Federal Occupational Safety and Health Act of 1970 (as amended) and with any rules, regulations, and revisions pursuant to that Act. It is intended that the work shall conform in every regard to all local, state, and federal laws, and to the ordinances and rules and regulations of the locality and the Department of Water, Sewers, Fire, Health, Buildings, and Police Department, whether specifically mentioned herein or not. Each contractor shall submit all requisite documents and notices, obtain and pay for any permits, inspections, approvals, etc. required for his work by such agencies or departments having legal jurisdiction over the work. Should anything in the plans or specifications be at variance with such rules and regulations, the contractor shall notify the Engineer, in writing, to that effect and shall not proceed until the matter in question is resolved.

1.4 PERMITS AND REGULATIONS

A. "Permits, Fees, and Notices" of the General Conditions of the contract shall govern. The Owner will acquire the Building Permit for this project and pay all charges associated therewith. Mechanical Contractors requiring other plan reviews, permits, and inspections shall secure and pay for same and shall include cost of same in their proposals.

B. Certificates showing the inspections have been made and approval has been received shall be submitted to the Engineer at the completion of the job prior to submission of request for final payment.

1.5 CODES AND STANDARDS

A. Unless otherwise specified, all materials and workmanship shall comply with the latest editions of the following codes and standards:

1. All Work: All Local, State Building Laws and Codes, and Americans with Disabilities Act.
2. Boilers: ASME and State Boiler Codes.
3. Combustion Equipment: NFPA and U.L. Labeled.
4. Cement, Metals, Pipe, Etc.: ASTM Standard Specifications. Tanks: State, including State Fire Marshall, EPA, and ASME Code for Unfired Pressure Vessels.
5. Piping: State and ANSI Codes for Pressure Piping.
6. Electrical Work: NFPA National Electric Code, NBS National Electrical Safety Code, and NFPA Standards.
7. Electrical Materials: U.L. List of Inspected Materials and NEMA Standards.
8. Connections to Public Utilities: Regulations of Local Departments of Water and Sewers, the local Gas and Electric Company, and the local Telephone provider.
9. Refrigeration Equipment: ANSI Code and State Code for specific requirements covering installation, maintenance, and operation of pressure piping and mechanical refrigeration systems and all applicable regulations implementing the Stratospheric Ozone Protection Provisions of the 1990 Amendments to the Clean Air Act.
10. Heating, Air Conditioning, and Ventilation Equipment: ASHRAE Code and Standards.
11. Fire Dampers, Safety Devices, Burners and Piping, Tanks, Etc.: NFPA Standards and Regulations.
12. OSHA Regulations: All work shall be performed in accordance with OSHA Regulations. The contractor shall have a competent person on site during the course of the project to ensure compliance with these federal workplace standards.

B. The above codes and standards are minimum requirements; however, when plans and/or specifications call for higher standards, the plans and/or specifications shall govern.

1.6 VERIFYING CONDITIONS

A. The work under this contract occurs on the site of and within the new and existing facilities. The work under this contract shall be scheduled and performed so as to provide a minimum of interference with the normal operation of the existing facilities.

B. Before submitting a proposal, contractors shall visit the site, and shall also carefully examine all bidding documents including those for other branches of the work, to satisfy themselves as to the nature and scope of all work to be done. Prints showing the original building architectural, structural, mechanical, and electrical work are available at the Engineer's office for contractors' review.

C. The submission of a proposal shall be taken as evidence that such an examination has been made and difficulties, if any, noted. Later claims for labor, work, material, and equipment required for any difficulties encountered which could have been foreseen, shall not be recognized, and all such difficulties shall be properly taken care of by the contractor at no additional expense to the Owner.

1.7 EXISTING WORK AND/OR CONDITIONS

A. The accompanying drawings and specifications illustrate and describe the existing conditions, mechanical utilities, sewers, water mains, pipes, ducts, conduits, etc. that are particularly relevant to the new work insofar as these mains are shown on existing records or evident by field inspections and tests; however, it is not the intent that these documents shall be construed to guarantee to the contractor the exact location of these items. Each contractor shall verify and determine the exact location of these items in the field, and all work under this contract shall be executed to avoid conflict with or damage to existing work. The work shall be planned and executed to avoid interference, as much as possible, with traffic and with the normal use of the existing facility.

B. All work involving hazards to persons shall be suitably barricaded and provided with warning lights or signs, as required.

C. Where necessary for the performance of the contract, existing work shall be cut, altered, removed, or temporarily removed and replaced. Work that is altered or replaced shall match similar existing work and said work shall be performed by trade applicable to the work; if said work is NOT shown or noted the Drawings relating to applicable trade, cost shall be paid by contractor requiring said work. However, unless otherwise provided by the drawings or specifications, no structural members shall be cut or altered without authorization of the Architect and Engineer. Work remaining in place, which is damaged or defaced by reason of work done under this contract, shall be restored in kind equal to its condition at the time of award of the contract by applicable trade as hereinbefore specified.

D. Existing work shall not be disturbed further than necessary for proper installation of new work. New work to be connected or made integral with existing work shall be properly erected to secure solidity and be continuous in finish. Such new work in extension of existing work shall correspond in all respects with that to which it connects, or similar existing sound work, unless otherwise specified.

1.8 EXISTING MECHANICAL FACILITIES

A. Where existing mechanical facilities and/or service lines occur in the area of the work and such facilities or lines are to be abandoned or changed, the contractor for the branch of work or trade involved shall cut off and properly cap the old lines, so as not to interfere with the new construction work. If any portions of such lines are required for the operation of an existing building the lines shall be altered and relocated to clear new construction and shall also be restored into service to provide continued operation of the existing building.

1.9 INTERRUPTION OF SERVICES

A. Work which requires the temporary turning off or shutting down the operation of existing mechanical and/or electrical facilities shall be done at times specifically approved by the Owner or utility company and the work shall be pre-scheduled and executed so there is a minimum outage of such services and/or delay in the new construction work.

B. Unscheduled interruptions of the facility will not be tolerated. The contractor shall exercise extreme caution, shall thoroughly inform his workmen and subcontractors of the critical nature of this work, and shall continually review the work procedure being followed in order to prevent accidental interruption of service. Before performing any act which could result in interruption of service, the contractor shall notify the Owner and Engineer of the hazards involved and the contractor shall proceed in a manner and at a time specifically approved by the Owner and Engineer.

C. All work necessitating the temporary turning off or shutting down the operation of existing mechanical and/or electrical facilities shall be done at times specifically approved by the Owner and Engineer in advance of any disruption of existing facilities.

1.10 MATERIALS AND EQUIPMENT

A. All materials and equipment entering into the work shall be approved by the Engineer, and must be new, without defects, and of the sizes and capacities shown on the drawings or hereinafter specified. All manufactured materials or equipment shall bear the identification mark of the manufacturer or, if required by the Engineer, shall be certified by an approved testing laboratory. All equipment shall operate within the manufacturer's range of speeds, guaranteed capacities, performance, etc. as indicated by the manufacturer's latest catalog and/or engineering data, shall be of proper size and dimension for the allocated space, and shall be placed in the space allocated in the proper construction sequence. Special consideration will be given to equipment which has been in successful field use or similar applications for at least three (3) years (exclusive of field tests), and to equipment which has an extended guarantee period in lieu of long use period. The contractor shall submit with his bid complete data on equipment he proposes to use; failure to so submit, or to meet these requirements fully and those of the specifications, shall be grounds for rejecting the items.

B. All electrical materials, apparatus, and equipment shall be new, of the make and characteristics specified, shall conform to NEMA standards, and shall be designed to comply with and be installed in accordance with the latest rules and regulations of the National Electrical Code, and all of the legally constituted public authorities having local jurisdiction. Verify the exact voltage and current characteristics at the building before ordering motors or similar equipment.

C. All motors shall be NEMA frame sizes, heavy duty, 40 degree C. ambient motors with ball or roller bearings and with maximum full load temperature rise not exceeding NEMA limits of temperature rise. All motors shall have adequate starting and protective equipment as specified or required, and shall have a conduit terminal box of size adequate to accommodate conduits and wires as sized on electrical drawings or as specified. The capacity of each motor shall be sufficient to operate associated driven devices under all conditions of operation and load without overloading or overheating and each motor shall be of not less than the horsepower indicated or specified.

D. Conduct such tests and adjustment of equipment as specified or necessary to verify performance requirements. Submit data taken during such tests.

1.11 QUIET OPERATION

A. The work shall be installed in such a manner that under all conditions of load it shall operate without sound or vibration which is objectionable in the occupied spaces, in the opinion of the Engineer.

B. In case of moving machinery, sound or vibration noticeable outside of the room in which it is installed or annoyingly noticeable inside its own room will be considered objectionable. Sound or vibration considered objectionable shall be corrected by the contractor.

1.12 PROTECTION

A. In performing this contract, safeguard workmen and the public and protect the work and equipment until final completion and acceptance. After delivery and before and after installation, protect work against theft, injury, or damage. Carefully store material and equipment received on site which are not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing materials. Protect related or adjacent work and the material of the other trades or the Owner from damage that might be caused by this work and make good any damage thus caused. Provide all safeguards, scaffolding, drop cloths, etc. as required.

B. No welding or soldering shall be done near combustible materials of any kind; all adjoining work, finished surfaces, glass, etc. shall be protected from flames, sparks, hot metal, etc. by metal guards or approved noncombustible drop cloths or barriers.

C. Each contractor shall replace any items or portions thereof wherever removed or damaged, in a manner equal to the original construction and finish, or where directed by the Engineer, he shall pay other trades to perform this work.

D. All mechanical equipment with a factory finish shall be protected during construction and must be free of dust, dirt, cement splatters, etc. when the building is turned over to the Owner. Dents and marred finishes shall be repaired to the satisfaction of the Engineer, or a replacement furnished where necessary.

E. Provide belt drives and rotating machinery with readily removable guards complying with OSHA requirements to enclose the drive completely and consisting of heavy angle iron frames, hinged and latched, with heavy galvanized iron wire crimped mesh or sheet steel securely fastened to frames.

1.13 EXECUTION OF WORK

A. The HVAC Work shall be performed and coordinated with the program of the General Contractor and the other subcontractors. Promptly upon award of the contracts, the subcontractors shall confer with the General Contractor and the Engineer and other subcontractors to prepare a time schedule for the completion of the various divisions and details of the work. Each subcontractor shall proceed diligently with the work and shall cooperate with the General Contractor and the other contractors to maintain the approved time schedule to the best of his ability and as conditions permit.

1.14 GENERAL SUPERVISION AND INSTALLATION OF WORK

A. Each contractor shall at all times give the work his best skill and attention, including adequate construction supervision over his work, employees, and subcontractors, and he shall fully cooperate with and confer with the Engineer and other contractors so that the best possible installation shall be obtained. Exact locations and relations are to be determined in the field, subject to the approval of the Engineer, and with preference to the dimensioned and architectural and structural drawings and approved shop and setting drawings.

B. Unless otherwise shown, pipes, ducts, etc. in rooms with finished ceilings, shall be concealed in furred ceilings, shafts, walls, and floors, and all work must be exactly and accurately located to conform with the spaces provided therefor. In general, all other new piping, ducts, etc. in mechanical equipment rooms, telephone rooms, etc. shall be exposed.

C. Install pipes, ducts, etc. in a neat and workmanlike manner, close to walls, generally as high as possible, true and square to the building, utilizing standard practices, and properly graded for correct functioning of the system involved; multiple lines in close proximity shall be coordinated and neatly grouped. Install work in proper construction sequence and arranged so as to be readily accessible for operation, maintenance, and repair; minor deviations from drawings may be made to accomplish this, but changes of magnitude or which involve extra cost shall not be made without approval. All fixtures, outlets, etc. shall truly center with the adjacent architectural finish. All work, both exposed and concealed, shall meet the approval of the Engineer regarding neatness of appearance, location, and practicability of installation. The Engineer reserves the right to direct the removal and replacement of any item which, in his opinion, does not present an orderly and reasonably neat and workmanlike appearance.

D. Each contractor shall familiarize himself with the work of the other contractors, shall perform and coordinate his work with the other contractors, shall lay out his work to meet conditions at the building, shall give freedom to and prevent conflict with the work of other contractors, and shall make reasonable modification in locations or arrangement from those indicated on the drawings if required to avoid conflicts or to conform to tile, wood, marble, or other architectural finish. From time to time as the work progresses, the contractor shall examine the work installed by others, insofar as it may affect his work, and he shall, before proceeding with the work, notify the Engineer in writing, if any condition exists which prevents the successful installation of his own work.

E. If the contractor places any work in violation of any of the above mentioned requirements, and conflicting or unworkmanlike conditions result, he shall, without additional charge, remove and reinstall or satisfactorily readjust such portions of his work as may be necessary and as the Engineer may direct. The Engineer's decision regarding such conditions shall be final.

1.15 PRICE BREAKDOWN

A. At the Engineer's request, the contractor shall furnish on a form approved by the Engineer a breakdown of cost of labor and material on each of the several items, the total of which shall equal the contract amount. This data shall be received in the office of the Engineer prior to the approval of the first estimate of payment of the contract, and shall be used for the purpose of proving monthly cost estimates.

1.16 ENGINEER'S OBSERVATION

A. A periodic inspection of the work by the Engineer, commonly referred to as supervision, is only for the express purpose of verifying compliance by the contractor with the contract documents. Such engineering inspections and services rendered by the Engineer or his representatives shall not be construed as the supervising of construction; nor the assuming by the Engineer of the duties and responsibility of the contractors nor making the Engineer responsible for providing a safe place or procedure for the performance of the work or for the contractor's employees or for subcontractors.

1.17 EXCAVATION AND BACKFILLING OF TRENCHES, ETC.

A. Unless otherwise specified, the HVAC Contractor shall do all excavation of trenches for piping, etc. in connection with his work, and after his work is in place and inspected by the Engineer and Civil Authorities, he shall backfill in layers of not to exceed six inches (6") in depth, thoroughly moistened, thoroughly rammed, tamped, and compacted to a density at least equal to the surrounding earth to minimize after settlement. If, in the opinion of the Engineer, the excavated material is unsuitable for backfilling, the contractor shall backfill with bank run gravel well compacted. The bottom of each pipe trench shall be filled with sand to an elevation of 6" above the top of the pipe. Top of backfill or trench surface shall be level with adjoining ground or surface; furnish additional material if required to fill trenches. All surplus earth shall be moved by this contractor and disposed of as directed by the Engineer. Compact backfill in trenches within building lines the same as specified in architectural branches.

B. Any sheet piling or shoring or pumping necessary shall be done by this contractor at his own expense and all trenches shall be dug in a careful manner, with bottoms properly pitched to insure perfect drainage and to provide uniform bearing and support for each section of pipe on undisturbed soil along its entire length, except where it is necessary to excavate for bell holes and for the proper sealing of pipe joints. The bottoms of all pipe trenches shall be excavated 6" below the bottom elevation of the pipe and backfilled with sand so at least one-third of the circumference of the pipe will rest firmly on tamped sand. These trenches shall be not less than 12" wider, nor more than 16" wider, than the outside diameter of the pipe to be laid therein; this requirement applies to the width at and below the level of the top of the pipe; the width above that level may be wider for proper sheeting and bracing and the proper installation of the work. Shoring, bracing, barricades, etc. shall be provided to protect the workmen and/or public amply; refer to the Ohio Bulletin No. 201 "Specific Safety Requirements Relating to Building and Construction Work".

C. Unless otherwise approved, the following minimum cover shall be provided above the top of underground pipes outside the buildings: Water lines, refer to elevations on plans.

D. Whenever wet or otherwise unstable soil, that is incapable of properly supporting the pipe as determined by the Engineer, is encountered in the trench bottom, such soil shall be removed to a depth required and for the length designated by the Engineer, and the trench backfilled to trench bottom grade with coarse sand, fine gravel, or other suitable materials, properly compacted.

E. Excavation near or under building footings shall be backfilled with concrete installed under the direction of the Engineer.

F. Where contractor elects to have any excavation work performed by a subcontractor, subcontractor must be approved by the Owner prior to commencing any work.

G. Construction Fence

1. Refer to Division 01.

1.18 RESTORATION OF SURFACES AND CONCRETE WORK

A. Unless otherwise specified, all new concrete work for parking lots, driveways, pads, etc. shall be provided by the general contractor. Unless otherwise specified, all new concrete work for pads, and all surfaces such as concrete floors, walls, paving, sidewalks, roof deck, or other surfaces disturbed in the execution of work, and which remain in use, shall be restored in kind by this contractor, or he shall pay the cost of such work.

B. Where this contractor has performed excavation work, this contractor shall backfill as hereinbefore specified in Paragraph 1.17.

C. In Landscaped Areas, such as grass or plantings, the final 6" of backfilling, grading, seeding, mulching, and planting shall be performed by a qualified, competent Landscaping Contractor approved by the Owner. The Mechanical Contractor shall include in his bid the cost of such landscaping services and shall warrant same as described under Paragraph 24.

1. This final 6" of backfill provided by the approved Landscaping Contractor shall consist of top soil complying with Ohio DOT 653.02; ph 6.0 to 7.0 or adjusted within these limits, raked to a uniform fineness and free of rock or stones 1" or greater in any dimension.
2. Where grass has been disturbed, the Landscape Contractor shall apply 8/32/16 organic fertilizer at rate of 1 lb. per 5 square yards and seed with 90-95% pure, 85% (minimum) germination seed of a mixture of 20% Rye grass, 40% creeping red fescue, and 40% Kentucky blue grass at a rate of 7 lbs. per 1000 square feet. Cover seeded areas with clean, weed free straw.
3. If shrubbery and plantings must be disturbed, the Landscaping Contractor shall either remove, maintain, and reinstall said plantings or the Landscape Contractor shall furnish healthy new shrubbery and plantings similar in kind to that which was removed. In either case, the Landscape Contractor shall fertilize and provide mulch around said plants.

D. In Blacktop Paved Areas, the work shall be performed by a qualified, competent Blacktop Contractor approved by the Owner; bids shall be based on and work shall comply with the following:

1. All materials and workmanship shall comply with the latest edition of the State of Ohio Department of Transportation Construction and Material Specification.
2. Paved areas shall match existing slopes and shall be without dips or low spots. All seams in paving to be flush and tight.
3. Begin rolling when mixture will bear roller weight without excessive displacement. Repair surface defects with hot material as rolling progresses. Cut out and patch defective areas and roll to blend with adjacent satisfactory paving. Continue rolling until maximum density is attained and roller marks eliminated.

4. Protect newly placed material from traffic until mixture has cooled and attained its maximum degree of hardness.
5. Remove and replace mixtures that become contaminated with foreign materials and defective areas and fill with fresh, hot mix properly compacted. Remove deficient areas for full depth of course. Cut sides perpendicular and parallel to direction of traffic with edges vertical. Apply tack coat before placing new mixture.
6. Thickness of Paving shall be as follows:
   a. Base: ODOT-301, compacted thickness 9".
   b. Prime Coat (over base): ODOT-408, 3.0 Gallons/Square Yard.
   c. Wearing Course: ODOT-404, two separate 1-1/2" layers each compacted; total compacted thickness 3".
   d. Tack-coat: ODOT-407, 0.20 Gallons/Square Yard.
7. Restore all parking space lines and space numbers using materials in accordance with Ohio Department of Transportation Section 621 - Pavement Marking.

E. Concrete Work, shall be performed by a qualified, competent, Concrete Contractor, approved by the Owner and work shall comply with the following:

1. Sidewalks shall be concrete, Class C, unreinforced, complying with ODOT 608. Width and finish shall match existing adjacent sidewalks. Sidewalks shall be the same depth as the existing adjacent sidewalks or 7" deep whichever is greater.
2. All other concrete for parking lots, driveways, and pads shall be 4000 PSI compressive strength concrete with reinforcing steel. Thickness of concrete for parking lots and driveways shall be not less than 7" thick. Reinforcing steel shall be 6" x 6" 58 pound welded wire fabric (WWF) top and bottom. All welded wire fabric shall be in flat sheets, not rolls.

1.19 SLEEVES, CUTTING, PATCHING, CLEANING, WATERPROOFING, ETC.

A. Provide and accurately set frames and Schedule 40 steel pipe sleeves for required openings in new work to minimize cutting. Perform all cutting, patching, etc. required to install the work. Use approved power operated boring machine for small holes wherever practical. Remove all rubbish incidental to the work. Where any work pierces waterproofing, provide all necessary sleeves, caulking, and flashing required to make openings absolutely watertight.

B. Refer to the ACI Code 381.71, Section 6.3 for limitations and requirements for penetrations and openings.

1.20 PATENTS

A. The contractor shall defend and guarantee the Owner against any expense, claims, litigation, etc. occasioned by the use in this work of any materials, devices, etc. covered by patents not owned by the contractor, or of which he is not a licensed user.

1.21 SHOP DRAWINGS

A. The contractor and subcontractor shall thoroughly check and verify all field measurements and shall submit to the Engineer, with such promptness as to cause no delay in his own work or that of any other contractor, copies of all shop or setting drawings and schedules required for the work of the various trades.

B. Subcontractors shall submit their shop drawings to the Engineer through the contractor under whom their work is to be performed.

C. The quantity of each shop drawing submitted initially, and when resubmitted, shall comply with the General Conditions. The contractor shall also furnish additional copies as may be needed.

D. The contractor shall thoroughly check shop drawings to ascertain their compliance with the Engineer's drawings and specifications, plainly marking all corrections on all copies of each drawing before submitting them to the Engineer for his general inspection and final review. All shop drawings shall bear the stamp of approval of the contractor. All drawings submitted without this stamp will not be reviewed by the Engineer but will be returned to the contractor for checking, stamping, and resubmission.

E. With respect to all shop drawings, the Contractor shall certify that their organization has thoroughly reviewed and approved each submittal; verified the products required; coordinate electrical characteristics with electric documents; coordinated and verified all associated field dimensions, adjacent construction work, and required clearances including verification that given product will fit in desired location; and determined that the work and the materials described in a given shop drawing submittal are in accordance with the requirements of the work and the contract documents. Any costs to remedy deficiencies resulting from failure to comply with the above requirements shall be borne solely by the contractor.

F. The contractor shall make every effort to submit shop drawings that comply with the drawings, specifications, and design intent. The Engineer will review up to two submittals for a given piece of equipment, material, etc. without cost to the contractor. If at the conclusion of the second review the Engineer cannot in good conscience allow the given item to be fabricated without further shop drawing review, the Contractor shall reimburse the Engineer for all time and expenses (postage, delivery, copying, etc.) for additional shop drawing review time. For the third submittal and after, the Contractor shall issue a Purchase Order to the Engineer with each subsequent submittal based upon a time and material review not to exceed $150/hour.

G. Where dimensions shown on shop drawings are field measurements, they shall be plainly noted as such. Where field measurements differ from the dimensions shown on the contract drawings, they shall be plainly noted.

H. The Engineer will check with reasonable promptness all shop drawings and schedules only for the conformance to the design concept of the project and compliance with the information given in the contract documents.

I. The Engineer's review of such drawings or schedules shall not relieve the contractor from responsibility for deviations from drawings or specifications. The contractor shall remain responsible for dimensions, quantities, and coordination with other trades unless he has, in writing, called the Engineer's attention to such deviations at the time of submission and secured his written approval. The Engineer's review shall not relieve the contractor from responsibility for errors in the shop drawings or schedules.

J. If data returned by the Engineer is marked REJECTED or REVISE AND RESUBMIT, all corrections shall be made as noted thereon, and drawings shall be resubmitted.

K. No equipment shall be manufactured and no fabrication shall be started on any work until shop drawings have been reviewed and stamped REVIEWED or FURNISH AS CORRECTED. If equipment manufacture or fabrication is begun using drawings stamped FURNISH AS CORRECTED, all corrections noted thereon shall be incorporated in manufacture or fabrication work.

L. Errors in shop drawings, or undue delays of the manufacturer in making corrections, are not acceptable excuses for changing delivery date or for imperfect fabrication.

M. At completion of the job, furnish four (4) additional copies of all shop drawings for Owner's manual as hereinafter specified.

1.22 INSTRUCTION BOOKLETS

A. Refer to Division 00.

1.23 AS-BUILT DRAWINGS

A. The contractor shall maintain a record set of drawings which he shall mark up with each deviation clearly indicated in red pencil. It shall be clearly identified as to the exact routing of piping, conduit, ductwork, and accessories. These drawings shall be turned over to the Engineer upon completion by the contractor and will become the property of the Owner. Data must be kept up to date as work progresses.

1.24 TEMPORARY SERVICES

A. Refer to Divisions 00 and 01.

1.25 CONTEMPLATED WORK

A. The work contemplated occurs on the site of and within the new and existing buildings.

B. The drawings and specifications for the mechanical and electrical portion of this project have been prepared by Motz Consulting Engineers, Inc., doing business as Motz Engineering.

C. The various items of work necessary for completion of this work are hereinafter specified under the respective section headings or shown on accompanying drawings, and shall be included in any contract or contracts made for completion of respective divisions of the work. Such contracts shall also include necessary details reasonably incidental to the proper execution and completion of such work.

1.26 PROCEDURE

A. The building will be in operation during the progress of this work. Prime Contractors and all subcontractors shall arrange their work so there will be no interruption to the Owner's business nor prevention of vehicular access to all portions of his property. All work shall be carried on as quietly as possible in a manner approved by the Engineer and Owner.

B. The following fire safety procedures shall be followed:

1. Fire Warden: Each contractor's job superintendent shall be appointed as fire warden, who shall be responsible for maintaining the fire safety procedures, hereinafter specified.
2. Portable Fire Extinguishers: The contractor will furnish portable fire extinguishers for their use. Contractors shall locate extinguishers near all welding and cutting operations and in all other areas where fire hazards exist from demolition and/or construction operations.
3. Access: Free access shall be maintained at all times to all permanent and temporary fire suppression equipment.
4. Exits: Clear means of egress shall be maintained at all times.
5. Welding and Cutting:
   a. Equipment shall be maintained in good condition. Tanks shall be stored outside building whenever practical in areas free from combustible materials and direct sunshine. Tanks inside building shall be located at no greater distance from work area than is necessary for safety.
   b. Operations shall be performed outside whenever practical and whenever possible; equipment not in use shall be stored outside. Operations performed inside the building within 10 feet of combustible materials shall have a noncombustible shield. Suitable fire suppression equipment shall be available in the work areas. At the conclusion of work, including lunch break and at end of day, work area shall be inspected twice at 15 minute intervals for any smoldering embers or live sparks.
6. Material Storage
   a. Flammable liquids shall not be mixed inside building nor shall flammable liquids within their own container be stored within 20 feet of the building. Flammable liquids stored inside the building shall be limited to 60 gallons and must be stored in approved storage cabinets.
   b. Covers over stored material shall be flame proof.
7. Temporary Partition: Partitions shall be constructed of fire retardant materials. Provide barriers as required to keep people and vehicles away from hazardous conditions. Provide temporary dust proof partitions between areas in which remodeling work occurs and occupied adjacent areas. Required exitways must be maintained as directed by the Owner.
   a. Scaffolding: Scaffolding materials shall be noncombustible.
   b. Rubbish Removal: Rubbish, debris, packing materials, etc. shall be removed from the building daily.
   c. Temporary Office and Tool Storage: Facilities located inside the building shall be noncombustible. Facilities located outside building shall be of noncombustible material or shall be located more than 30 feet from the building.
   d. General
      (1) Smoking: No smoking will be permitted within this building.
      (2) Dirt, Dust, and Vapors:
         (a) Dirt, dust, or vapors can disrupt and damage University equipment. For any operations producing dirt, dust, lint, filing, or airborne microscopic particles/vapors, arrangements must be made to contain the contaminants at their source.
         (b) Operations performed inside building shall be performed within a mechanical room whenever possible; work performed outside these areas, when necessary, shall be performed only after receipt of Owner's approval.
         (c) During any cutting or drilling of any holes (wet or dry), a vacuum cleaner shall be operated in the area of the work in order to remove dirt and dust. A thorough clean-up shall be accomplished

immediately after cutting or drilling each hole.

1.27 MOVING MATERIALS

A. If it becomes necessary at any time during the progress of this work to move materials which have been temporarily located and which are to enter into the final construction, the contractor furnishing said materials shall, when so directed by the Engineer, move them or cause them to be moved. Cost of such moving shall be included in the contract price.

1.28 ACCIDENT PREVENTION

A. Precaution shall be exercised at all times for the protection of persons and property. The safety provisions of applicable law, building, and construction codes shall be observed. Machinery, equipment, and other hazards shall be guarded in accordance with safety provisions of the "Manual of Accident Prevention in Construction" published by Associated General Contractors of America to the extent that such provisions are not inconsistent with applicable law or regulations.

1.29 PROPERTY PROTECTION

A. All hoisting shall be done with proper tag lines and buffers to prevent damage to the sides of the building. Where it is necessary to hoist materials to the roof, the parapets at top of the building and the roof where materials are landed from hoists shall be protected with heavy wood covers. Parapet protection shall be placed on both sides and top, and shall extend far enough on either side of landing point to insure adequate cover. The roof, from the landing point at parapet to final location of material, shall be adequately protected by planks laid side by side on roofing and spiked together on outside edges with planks running at right angles to main planking. The roof shall be adequately protected against leaks at all times.

B. Where hoists are erected on the roof for hoisting material up the side of the building, the roof shall be adequately protected against abrasion or other damage. Materials stored on the roof shall be placed on planks or other protection approved by the Engineer and shall be placed only at locations approved by the Engineer.

C. If hoisted materials are taken through windows, the jams, head, and sill shall be adequately protected with wood planking or proper buffers.

D. Any work, equipment, or property damaged during construction of this project and due to operations under this contract shall be repaired or replaced by this contractor, without additional cost to the Owner. Upon completion of the work, the contractor shall remove all protections herein specified.

1.30 REMOVAL OF RUBBISH

A. It shall be each contractor's duty to keep the building and surrounding premises clean, free from rubbish of every description. No rubbish, crating materials, packing, or dirt shall be allowed to accumulate at any time, but shall be removed at once and hauled away.

B. Each trade shall be responsible for its own tools and materials during the periods of rubbish removal but contractors shall use reasonable care in removal of rubbish to protect the tools and materials of others against loss or damage. The Owner reserves the right, in the event that removal of rubbish is not promptly and properly carried out by the Contractors to have rubbish removed and to charge the cost of its removal to the contractor.

C. Also, refer to Division 00.

1.31 MATERIAL SAFETY DATA SHEETS (MSDS)

A. The contractor shall obtain and maintain on-site during the course of the project the Material Safety Data Sheets (MSDS's) for all chemicals or products containing chemicals that may be considered toxic or hazardous. The MSDS's are to be forwarded to the Office of Environmental Health and Safety upon completion of the project.

1.32 COORDINATION DRAWINGS

A. GENERAL

1. The General Contractor shall be in charge of the coordination drawing process. The General Contractor shall be responsible to resolve all conflicts and settle any disputes resulting from this work.
2. The contract documents are diagrammatic in nature. Offsets and fittings etc., will be required for complete coordination and are to be included in base bid. Additional monies shall not be awarded for offsets. Only if major rerouting with significant proven net increases in materials warrant additional compensation, as reviewed by the Architect, Engineer, and Owner.
3. Discrepancies in the field shall be resolved between the respective field foreman. When a dispute cannot be resolved, the coordination drawings shall be re-examined for rights.
   a. Documented, dimensioned, coordinated work shall take precedence.
   b. The Owner shall not pay any additional monies for re-work of a particular trade. In general, uncoordinated work will not be tolerated.

B. COORDINATION DRAWING PROCESS

1. The HVAC Contractor shall have precedence over all other trades for the assignment of available space allocated for work installations. However, rerouting for graded pipe lines may be necessary and desirable provided the Engineer approves rerouting over specific areas.
2. The General Contractor shall ensure that all trades pre-coordinate the preparation of their layouts and shop drawings with each other. The following procedure shall be followed.
3. The HVAC Contractor shall prepare and pre-coordinate the preparation of his shop drawings with the General, Fire Protection, Plumbing, and Electric Contractors. He shall distribute drawings/CAD/Revit file of the duct and piping layout to the Fire Protection, Plumbing, Electric and General Contractors.
   a. Each of these contractors shall use drawings/CAD/Revit files in the preparation of their own shop and installation drawings. After the HVAC Contractor has completed indicating his work, he shall deliver files to the Fire Protection Contractor who shall transcribe his work thereon, and then deliver this "master" file to the Plumbing Contractor who shall transcribe his work thereon and then deliver this "master" file to the Electric Contractor who shall then transcribe his work thereon, and then deliver this "master" file to the General Contractor who shall transcribe his work thereon. Each contractor shall indicate his work in a different color, layer, etc. Each contractor shall check for "clashes".
4. After the General Contractor has completed his layout, he shall deliver "master" file to the HVAC Contractor. The General Contractor shall then hold a coordination meeting to clear all possible areas of conflict. A representative of all said contractors, the Architect, and the Engineer shall be in attendance, and conflicts, if they exist, shall be cleared at this meeting. In the event of a critical conflict, the

Architect and the Engineer shall decide where and to what degree each contractor shall alter their layout so that each has sufficient space for installation of their work.

5. When all "Coordination Drawings" have been fully coordinated and reviewed by the Architect, General Contractor, and Engineer, the HVAC Contractor shall distribute electronically the files to each of the General, Fire Protection, Plumbing, Electrical Contractors, the Architect, the Engineer, and the Engineer's field representative, and the Owner.
6. The General Contractor shall be responsible for the safekeeping of the complete Coordinated Drawing Files and shall maintain them on their server until the completion of the project.
7. Additional copies of Coordination Drawing Files (over and above those mentioned above) will be provided to any requesting interested party.
8. Delineation requirements for Coordinated Drawings shall be as follows:
    a. HVAC
        (1) By accurate dimensions all horizontal piping and ducts shall be located from column center lines (or other permanent base lines as determined by the Engineer). Locate and dimension terminal units, fire dampers, registers, grilles, and diffusers. (Refer to Reflected Ceiling Plans.)
        (2) All terminal units shall be located to avoid electrical equipment, piping, and furniture and walls above.
        (3) Vertical riser piping and ducts shall be located and dimensioned from column center lines in two (2) directions. Each vertical piping and duct riser shall be shown in its total length when concealed inside of shaft.
        (4) Each horizontal duct run shall be drawn to scale with size (width and depth noted) and an ELEVATION (bottom of duct) shall be clearly noted. This elevation shall clear the ceiling below or floor above and this elevation plus duct depth shall clear all beams in the floor above.
        (5) HVAC Shop Drawings shall be made using not less than 1/4 inch scale per foot.
    b. Fire Protection, Plumbing, and Electric Systems
        (1) Location of lines shall be indicated from column center lines; indicate size, indicate center line ELEVATION of piping, and indicate drainage pitch as required. Where a long drain line is indicated, center line ELEVATION shall be located and pitch indicated at intervals not to exceed twenty (20) feet.

        (2) Conduits less than one (1) inch in size need not be shown but the Contractor for Electrical Work shall select a location for small conduits which will not cause conflict with other trades. Conduits not indicated on the COORDINATION DRAWINGS shall be field offset to clear all conflicts.
    c. General
        (1) All furrings and holes shall be indicated.
        (2) All new ceiling heights shall be indicated.

1.33 ELECTRONIC FILES OF ENGINEERING DRAWINGS

A. The AutoCAD Model will be provided to each contractor upon executing a disclaimer provided by the Architect and/or the Engineer.

B. Refer to Division 01.

1.34 INSTRUCTION OF PERSONNEL

A. The HVAC Subcontractor shall provide free on site instruction in the proper use of installed equipment to designated representatives of the Owner, sufficient to ensure safe, secure, efficient, non-failing utilization, and operation of systems. This instruction shall include the following:
   1. One Site Training: Provide a minimum of 24 hours of training for owner's staff. Submit a syllabus to the Engineer prior to the first session.
   2. Support: Provide a minimum of 16 hours of support either on site or by telephone to answer operations questions.

PART 2 – (NOT USED)

PART 3 – (NOT USED)

END OF SECTION 23 04 00

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SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Concrete bases.
11. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, 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 chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.8 MATERIALS

A. All materials entering into the work shall be approved by the Engineer, and must be new, without defects, and of the sizes and capacities shown on the drawings or hereinafter specified.

All manufactured materials shall bear the identification mark of the manufacturer or, if required by the Engineer, shall be certified by an approved testing laboratory.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 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. 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.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150-psig minimum working pressure as required to suit system pressures.
   1. Manufacturers:
      a. Capitol Manufacturing Co.
      b. Central Plastics Company.
      c. Epco Sales, Inc.
      d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   1. Manufacturers:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Central Plastics Company.
      d. Pipeline Seal and Insulator, Inc.
   2. Separate companion flanges and steel bolts and nuts shall have 150 psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
   1. Manufacturers:
      a. Calpico, Inc.
      b. Lochinvar Corp.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
   1. Manufacturers:
      a. Perfection Corp.
      b. Precision Plumbing Products, Inc.
      c. Sioux Chief Manufacturing Co., Inc.
      d. Victaulic Co. of America.

2.5 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   1. Manufacturers:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Metraflex Co.
      d. Pipeline Seal and Insulator, Inc.
   2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: 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.

2.6 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.

2.7 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
1. Finish: Polished chrome-plated.

D. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

2.8 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 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw.
      g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
      h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
      a. Pipe Sleeves: For pipes smaller than NPS 6.
      b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
      c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

R. Verify final equipment locations for roughing-in.

S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
   4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Painting, if any, of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

1. All concrete pads and bases shall be installed by the HVAC Contractor.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.9 PIPE HOLES

A. Where new piping is to be installed through existing concrete floors or roof, and where holes do not exist, this contractor shall bore new holes and shall protect the building from moisture and/or dust at these locations. Space between bare pipe or insulation and hole shall be caulked so as to make airtight, waterproof, and with fire resistive rating equal to or greater than the construction penetrated.

B. In fire rated walls, space between bare pipe or insulation and hole shall be filled with the following applicable 3M Brand fire barrier products: Model CP25N/S no-sag caulk, moldable putty, Model FS-195 wrap/strip or Model CS-195 composite sheet.

C. Contractor shall cut and patch all openings in concrete or masonry walls, furnish and set sleeves hereinafter specified, and patch around same.

D. The contractor will close all openings resulting from the removal of piping. Patching work shall match and be integral with existing surrounding surfaces.

3.10 PIPE SLEEVES

A. Where new pipe passes through concrete or masonry walls, inside partitions, or furrings, pipe sleeves ½" larger in diameter than the outside of pipe or pipe covering for which they are intended shall be provided and set in place by this contractor. Contractor shall do all cutting and patching of construction required for the proper installation of the sleeves.

B. No sleeves shall be installed through structural beams or concrete joists unless specifically shown and/or approved.

C. Sleeves through exterior walls below grade shall be Schedule 40 cast iron pipe; all other sleeves shall be Schedule 40 steel pipe. All sleeves shall be machine cut. Space between bare pipe or insulation and sleeves shall be caulked so as to make airtight and waterproof and with fire resistive rating equal to or greater than the construction penetrated. In outside walls, space between sleeve and pipe shall be filled with resilient compressible packing with outside face of joint sealed with permanently flexible caulking material.

D. Wall sleeves shall finish flush with wall lines, and where lateral movement of pipe must be provided for, the sleeves shall be oval in section. Floor sleeves shall be set with bottom flush with finished construction below and top extending 1" above finished floor in wet areas and 1/4" above finished floor in all other areas.

E. For pipe penetrations in exterior building wall, provide mechanical sleeve seals of modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates. Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1" (25 mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals. Install steel pipe for sleeves smaller than 6" (150 mm) in diameter. Install cast-iron “wall pipes” for sleeves 6" (150 mm) in diameter and larger. Assemble and install mechanical sleeve seals according to manufacturer’s written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal. Mechanical sleeve seals shall be manufactured by Calpico, Inc., Metraflex Co., or Thunderline/Link-Seal.

3.11 EQUIPMENT

A. All equipment shall be thoroughly cleaned of dust and debris before turning over to the Owner.

3.12 PAINTING

A. All general painting of piping, insulation, and equipment, if any, will be performed by the General Contractor. Unless otherwise noted, where this contractor has cut finished building surfaces, this contractor shall patch and paint these surfaces.

3.13 DRAIN PIPING

A. Extend drain piping from all drains and cooling coil discharge all at new air conditioning units, etc. to spill over the nearest floor drain or janitor’s receptor.

B. Provide valved blowoff on all strainers and pipe to floor drain; where no sizes are shown, blowoff shall be full size of strainer connection.

END OF SECTION 23 05 00

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SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.

3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 05 13

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SECTION 23 05 19 - PIPING SPECIALTIES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Strainers.
2. Unions.
3. Dielectric Fittings and Isolating Flanges.
4. Pressure Gauges.
5. Thermometers.
6. Pressure-Temperature Test Stations.
7. Air Vents.
8. Expansion Joints.
9. Access Panels.
10. Wall, Floor, and Ceiling Plates.
11. Flashings.
12. Wells and Outlets.

1.3 SUBMITTALS

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

B. Product Certificates: For each type of device, from manufacturer.

C. Operation and Maintenance Data: For each device to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 STRAINERS

A. Strainers shall be Mueller, McClear, Sarco, Armstrong, or Crane equal to the following types:
1. Strainers shall have stainless steel screens or baskets with the following perforations: City or chilled water - 1/16" (3/4"-4"pipe) and 1/8" (5" and larger pipe).

B. Y-Pattern Strainers
   1. Installed in Copper Pipe: Mueller No. 351M, Class 125 cast bronze body with screwed ends and cast bronze cover flange with BUNA-N O-ring seal and plugged blowoff outlet and stainless steel screen.
   2. 2" and Smaller Installed in Steel Pipe: Mueller No. 11M, Class 250, cast iron body with screwed ends and threaded and gasketed cap with plugged blowoff outlet and stainless steel screen.
   3. 2-1/2" and Larger Installed in Steel Pipe: Mueller No. 758, Class 125, cast iron body with flanged ends, cast iron cover flange and plugged blowoff outlet and stainless steel screen.
   4. Strainers in 100 PSI and Higher Steam Piping: Armstrong, B1SC, 600 PSI, Cast steel.

2.2 UNIONS

A. Unions shall be installed adjacent to all new screwed valves and on all new pipes wherever necessary for convenience in erecting and repairing whether shown on the drawings or not. Unions in copper tubing shall be all bronze type with ground joint; all other unions 2" and smaller shall be malleable iron bronze mounted, with ground joint. Larger unions shall be standard cast flanges with gaskets.

2.3 DIELECTRIC FITTINGS AND ISOLATING FLANGES

A. In piping 2" and smaller, furnish and install Epco dielectric unions at juncture of copper and steel or iron piping, fitted with dielectric insulators and/or gaskets to prevent contact of dissimilar metals; each end to be of same material as pipe to which it is connected.

B. In piping 2-1/2" and larger and at flanged fittings and equipment, furnish and install isolation flanges at juncture of copper steel or iron piping, fitted with plastic sleeves around bolts and plastic washers under the bolt heads and under the nuts to isolate bolt from both flanges.

2.4 PRESSURE GAUGES

A. For Water Systems gauges shall be a 4-1/2" Palmer No. 40 SWLM, Weksler, Trerice, or approved equal, glycerine filled, pressure gauge each with stainless steel bourdon tube with stainless steel socket, 1/4" NPT stainless steel bottom connection, 2 of 1% accuracy, stainless steel case without mounting flange but with polished stainless steel ring, and with No. 872 pressure snubber and No. 735 needle valve.

B. For Steam System gauges shall be a 6" Trerice No. 500X, Palmer, Weksler, or approved equal, bronze pressure gauge with No. 865 cock and syphon.

2.5 THERMOMETERS

A. Thermometers shall be Palmer No. 3AA, Trerice, or Weksler, 9" industrial stem thermometer each fully adjustable to any angle with cast aluminum plate case, stainless steel trim, and stainless steel well in piping.

2.6 PRESSURE-TEMPERATURE STATIONS

A. Pressure-Temperature Stations shall be a Peterson Engineering Co., Inc. No. 710, Sisco, or approved equal, 2" pressure-temperature test plug. Deliver to Owner one Peterson Engineering Co., Inc. Sisco, or approved equal, test kit complete with carrying case equipped with two pressure gauges each with adapter and two thermometers each with adapter.

2.7 AIR VENTS

A. Automatic Air Vents shall be Hoffman No. 78, Anderson, Crane, Fischer, or equal, 2" automatic air vent trap with cast iron body, and bronze float and valve mechanism, and with discharge piped to floor drain. Air vents shall have an operating pressure of 150 PSI and a withstand hydrostatic pressure of 450 PSI.

B. Manual Air Vents shall be a Hoffman No. 500 Anderson, Crane, Fischer, or equal. Air vents shall have an operating pressure of 75 PSI and a withstand hydrostatic pressure of 200 PSI.

2.8 ACCESS PANELS

A. Where new valves or other equipment, requiring operation or maintenance, occur in inaccessible locations, such as above suspended ceilings, behind walls, etc., access panels shall be provided. Where access panels are not indicated on Architectural drawings, this contractor shall furnish and install flush metal access panels with frames of ample size for removal or repair of such equipment. Where removable ceiling panels occur, access panels will not be required.

B. Access doors shall be Milcor, or equal, of the following types: in plaster walls: Style DW; in masonry walls: Style M; in plaster ceilings: Style AP; in inaccessible acoustical ceilings: Style AT. Doors in fire rated walls shall have a fire rating equal to or greater than the wall. Minimum size for access doors shall be 16" x 16".

2.9 WALL, FLOOR, AND CEILING PLATES

A. Wall, floor, and ceiling plates shall be installed at exposed points where new pipes pass through walls, floors, and ceilings. Plates shall be a heavy nickel plated metal plate of split type with springs or screws for securing flange to pipe. Plates for insulated pipes shall be of proper size to allow covering to pass through continuously.

2.10 FLASHINGS

A. Flashings for vents, roof drains, and floor drains shall be Noble Chloraloy heavy gauge vinyl. Verify size and coordinate installation with Roofing and General Contractor.

2.11 WELLS AND OUTLETS

A. Contractor shall install all wells and outlets in piping where required for instruments and controls specified herein and in the controls section, all of proper size and type for the device

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install valve and snubber in piping for each pressure gage for fluids.

G. Install test plugs in piping tees.

H. Install flow indicators in piping systems in accessible positions for easy viewing.

I. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

J. Install permanent indicators on walls or brackets in accessible and readable positions.

K. Install connection fittings in accessible locations for attachment to portable indicators.

L. Install thermometers in the following locations:
1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic coil in air-handling units.

M. Install pressure gages in the following locations:
1. Discharge of each pressure-reducing valve.
2. Suction and discharge of each pump.

3.2 CONNECTIONS

A. Install devices adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 23 05 19

SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Ball valves.
2. Check valves.
3. Globe and angle valves.
4. Gas cocks.
5. Butterfly valves.
6. Balancing valves.

B. Related Sections:
1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   2. ASME B31.1 for power piping valves.
   3. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set angle, gate, and globe valves closed to prevent rattling.
   4. Set ball and plug valves open to minimize exposure of functional surfaces.
   5. Set butterfly valves closed or slightly open.
   6. Block check valves in either closed or open position.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:
   1. Gear Actuator: For quarter-turn valves NPS 6 valves at chilled water pumps.
   2. Handwheel: For valves other than quarter-turn types.
   3. Handlever: For quarter-turn valves NPS 4 and smaller.
   4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
   1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
   2. Butterfly Valves: With extended neck.

F. Valve-End Connections:
   1. Flanged: With flanges according to ASME B16.1 for iron valves.
   2. Solder Joint: With sockets according to ASME B16.18.
   3. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

H. Furnish and install all valves where shown or required for the proper operation of the system.

I. Control valves requiring frequent operation shall be globe valves, and all valves operated only at intervals shall be gate valves, unless otherwise specified or indicated on plans.

J. Valves shall always be placed in accessible positions for operation and repairs.

K. Provide chain operators on all valves 3" and larger installed more than 7'-0" above mechanical equipment and floors.

L. Valves 2" and smaller in copper pipe shall have solder ends and in steel pipe, they shall have threaded ends. Valves 2-1/2" and larger shall be flanged valves or butterfly valves.

M. Valves 2" and smaller shall be ball valves unless shown otherwise and valves 2-1/2" and larger shall be butterfly valves unless shown otherwise.

N. All valves shall be designed for the following working pressures and shall be Powell, Lunkenheimer, Crane, Grinnell, Stockham, or equal make, and equal in quality.

2.2 BALL VALVES

A. Ball Valves shall be Conbraco Industries, Inc., Watts, or Nibco, full ported ball valves with cast bronze body with sweat or threaded ends, chromium plated bronze ball, stem, handle, teflon packing rings, seals, seats, etc. Each valve shall be rated 400 PSI WOG and 150 PSI steam and shall be bubbletight against 100 PSI.

B. Each locking ball valve shall have "Latch-lock" handle.

C. Each valve installed in insulated piping shall have 2-1/4" stem extension.

D. Ball valves shall be of the following types:

SERVICE	PORTING	APOLLO NO.
Drain Valves with Hose Fitting Capped	Standard	78-104
All Other Drain Valves	Standard	70-100/200
All Other Valves	Full	77-100/200

2.3 MANUALLY-OPERATED BUTTERFLY VALVES

A. Chilled water butterfly valves shall be Keystone K-Lok Figure 362, DeZurick, Norris, Demco, Crane, Watts, Grinnell, or approved equal high performance butterfly valves suitable for 200° F at a system shutoff pressure of 740 PSI.
   1. Valves shall have carbon steel body with full lug type body with holes drilled and tapped for 150 PSI flanges, stainless steel shaft and disc, stainless steel/nitride bearings, and with EPDM seat.

2. Valves “6” and larger at valves at pump discharge shall be equipped with enclosed gear operators; smaller valves shall be equipped with notched plate and rotary handle.

B. All other butterfly valves 12" and smaller shall be Keystone Figure 222, DeZurik, Norris, Milwaukee, Watts, Grinnell, or approved equal butterfly valves, suitable for 225 PSI line pressure, and shall be bubbletight bidirectionally against 225 PSI differential pressure and 250 PSI dead end pressure (30°F. to 225°F.).

C. All butterfly valves shall have cast iron body of short laying length design with lug type body with holes drilled and tapped for 150 PSI flanges, stainless steel shaft, self-lubricating Teflon shaft bearings, and aluminum bronze disc with EPDM rubber seat secured to valve body.

D. Valves 6" and larger and valves at chilled water pumps discharge shall be equipped with enclosed gear operator; smaller valves shall be equipped with notched plate and rotary handle.

2.4 AUTOMATIC BUTTERFLY VALVES

A. Automatic Butterfly Valve shall be of same type, manufacturer, and construction as manually-operated butterfly valves specified in Paragraphs 2.5.

B. The valve shall be equipped with Keystone Figure 777 electric actuator capable of producing sufficient output torque for infrequent operation. The operator shall include permanently lubricated self-locking gear train, a manual override which does not require the use of levers or latches, mechanical travel stops, a U. L. listed motor with thermal overloads and visual mechanical position indicator all mounted in a NEMA 4X enclosure. The valve actuator shall also include the following accessories:

C. A combined servo amplifier and speed control module which accepts analog inputs of mA, voltage or resistive command signals. The module shall incorporate a solid-state comparator and switching circuits with zero, gain, span and deadband adjustments. The speed control function shall vary actuator operating times. Opening and closing speeds shall be adjusted independently.

D. A valve position transmitter which provides a 4-20 mA output signal which is proportional to the actuator position. A 24 VDC power supply shall be supplied as part of the control package.

E. A 115 volt, 3 watt, thermostatically controlled, anti-condensation heater shall be installed in the motor/switch compartment.

2.5 CALIBRATED BALANCING VALVES

A. Calibrated Balance Valves shall be Bell & Gossett "Circuit Setter" type C.B., or Armstrong Type CBV, all bronze, calibrated balancing valves with indicator and two capped readout ports.

2.6 BALANCING VALVES

A. Calibrated Balance Valves shall be Bell & Gossett "Circuit Setter" type C.B., or Armstrong Type CBV, all bronze, calibrated balancing valves with indicator and two capped readout ports.

B. Other Balancing Valves 1-1/2" and larger shall be Peter Healy all bronze plug valves; other balancing valves 1-1/4" and smaller shall be Ohio Brass Co. No. 3800 equip bronze valves.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. 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.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow.

3.3 ADJUSTING

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

END OF SECTION 23 05 23

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SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following hangers and supports for HVAC system piping and equipment:

1. Hangers and supports.
2. Supports – vertical piping.
3. Anchors and guides.
4. Equipment pads, curbs, and bases.

B. Related Sections include the following:
1. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-protection piping.
2. Division 23 Section " Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI7.
1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

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

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Pipe stands.
3. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, “Structural Welding Code – Steel.”

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 HANGERS AND SUPPORTS

A. Horizontal piping 6" and smaller shall be supported by steel clevis or split ring malleable iron hangers with adjustable rods; 8" and larger piping shall be supported from single pipe rolls with adjustable sockets with one hanger rod for 8" pipe and two hanger rods for 10" and larger pipe.

B. For all other piping: hangers for pipe sizes 6" through 12" shall be spaced not more than 12'-0" apart; hangers for smaller pipe shall be spaced not more than 10'-0" apart; provide one additional hanger at each location where pipe changes direction.

C. Hangers for suspended piping shall be Grinnell, Fee and Mason or Gateway hangers each to the following Grinnell Figure Numbers. Hangers shall be Grinnell Fig. 108 split malleable iron pipe ring and Fig. 114 turnbuckle, for pipes 2" and smaller; Grinnell Fig. 260, steel clevis for 2-1/2" to 6" pipe; Grinnell Fig. 181 adjustable steel yoke pipe roll for 8" and 10" pipe; and Grinnell No. 171, pipe roll with adjustable sockets for larger pipes. Adjustment shall be 2" for securing proper grade and alignment.

D. Pipe supported on floor shall be supported on Grinnell Fig. 259, Fee and Mason, or Gateway pipe consisting of cast iron yoke and nuts. Install on 3" Schedule 40 pipe with steel base plate.

E. Pipe supported on steel support racks shall be supported on Grinnell Fig. 271, Fee and Mason, or Gateway pipe roll stands consisting of cast iron pipe roll, steel rod and cast iron stand.

F. For any copper pipe or tubing, provide copper coated steel hangers or lead liners for hangers or riser clamps supporting copper tubing (if any are in direct contact with the tubing) and insulate so as to prevent condensation. In no case, solder one line to another for support.

G. On piping conveying chilled water, the pipe rings or pipe rolls shall go around outside of the covering; provide galvanized steel formed half diameter bearing plates around the bottom half of pipe covering; for piping insulated with fiberglass insulation, plates to be lined with short length of foam glass insulation to be provided by Insulation Contractor; for piping insulated with foamed plastic insulation, plates to have blocking as detailed on drawing; for 8" and smaller pipe, plate shall be 12" long, 12 gauge; for 10" and larger pipe, plate shall be 24" long, 10 gauge. Provide copper coated steel hangers or lead liners for hangers or riser clamps supporting copper tubing (if any are in direct contact with the tubing) and insulate so as to prevent condensation.

H. Supports for hangers shall be solid rods of ASTM A-107 steel with running threads on both end rods or shall be all-thread rods. Rods shall be sized according to the requirements of NFPA bulletins and shall be not less than the following:

	SINGLE ROD	TWO RODS
3/4" to 2" Pipe	3/8" Dia.	
2-1/2" to 3-1/2" Pipe	1/2" Dia.	
4" to 5” Pipe	5/8” Dia.	1/2" Dia.

I. All rods shall be adjustable and shall be accurately plumbed and double nutted.

J. Piping shall not be supported from ceiling or floor grid, ductwork, electric conduit, heating or plumbing lines, or any other utility lines, and vice versa. Each utility and the ceiling grid system shall be a separate installation and each shall be independently supported from the building structure. Where interferences occur, in order to support ductwork, piping, conduit, ceiling grid systems, etc., trapeze type hangers or supports shall be employed and shall not be located where they interfere with access to mixing boxes, fire dampers, valves, etc.

K. Hangers under new concrete construction shall be supported by concrete inserts, Grinnell Fig. 282, Fee and Mason or Gateway, malleable iron body and nut. Where additional supports are required, install, per manufacturer's installation instructions and load ratings (with 5:1 safety factor) Rawl or Hilti expansion bolts.

L. Adjacent to concrete and block construction, hangers shall be supported by Rawl or Hilti expansion bolts installed per manufacturer's installation instructions and load ratings (with 5:1 safety factor).

M. Under steel beam construction, hangers shall be supported by beam clamps, Grinnell Fig. 218, Fee and Mason, or Gateway malleable iron jaws with steel rod and nut. Where intermediate support between beams is required, contractor shall weld angle iron supports between beam or joists, top of angles being level with top of building steel.

N. Any cutting and patching required to install hangers, supports, rods, or inserts shall be performed by this contractor.

2.2 SUPPORTS - VERTICAL PIPING

A. Supports - vertical piping shall be supported at intermediate floors with Grinnell Fig. 261, Fee and Mason, or Gateway steel riser clamps placed under hub, fitting, or coupling, and with approved solid bearing on floor construction.

2.3 ANCHORS AND GUIDES

A. Anchors and guides shall be heavy substantial galvanized steel anchors of type suitable for the conditions at each location, and place on the pipe lines where shown or necessary to force the expansion in the proper direction. Horizontal anchors shall be constructed of structural angles or shapes properly fabricated and securely bolted to the construction and fitted with clamps and welds to secure the piping. Guides, independent of the expansion joints, shall be installed on pipe lines on each side of joint completely in accordance with manufacturer's recommendations

but not less than one guide at 4 pipe diameters and another guide at 14 pipe diameters from each joint to prevent buckling of piping. Certain guides for piping 4" through 6" size, where indicated, shall be Grinnell No. 255.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

E. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

F. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

G. Install lateral bracing with pipe hangers and supports to prevent swaying.

H. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

I. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

K. Insulated Piping:

   1. Attach clamps and spacers to piping.

      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.

b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

3. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
b. NPS 4: 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.

4. Pipes NPS 8 and Larger: Include wood inserts.
5. Insert Material: Length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and attachments for general service applications.

F. Use copper-plated hangers and attachments for copper piping and tubing.

3.6 PAINTING

A. For any exterior hangers and support devices that are not galvanized, these components shall be painted. This contractor shall include the painting of all new steel pipe racks and steel supports including all imbedded weldments in manholes as follows:
   1. Painting Materials
      a. All paint shall be Porter PPG, Glidden, Sherwin Williams, or Benjamin Moore to the following Porter PPG paints:
         1) Prime Coat: 1 Coat – PPG Speedhide 6-208 Exterior Rust Inhibitive Steel Primer.
         2) Finish Coat: 2 Coats – PPG PITT-TECH DTM 90-474 Satin Acrylic Enamel.
   2. For general surface preparation, application information, product data, etc., refer to manufacturer's instructions.
   3. Application of Paint
      a. Surfaces shall be prepared and paint shall be applied in accordance with manufacturer's instructions using applicators and techniques best suited for materials and surfaces to be painted; however, spray painting is NOT acceptable.
      b. Color of paints shall be as selected by the Owner from manufacturer's standard colors.
      c. Protect work of other trades.

END OF SECTION 23 05 29

SECTION 23 05 48 - VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Sound Insulation.
   2. Vibration Isolator.

1.3 DEFINITIONS

A. 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 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 component used.
      a. Annotate to indicate application of each product submitted and compliance with requirements.
   3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Coordination Drawings: Show coordination of bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints.

C. Welding certificates.

D. Qualification Data: For testing agency.

E. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.5 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. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 SOUND INSULATION

A. Where specified, pipe hangers shall be equipped with spring and elastomer sound insulators of proper size for the dead load at each hanger, without metal-to-metal thru-contact. Insulators shall be Peabody Noise Control, Inc. Type SFH insulators, Mason Industries, Korfund, Vibration Mountings & Controls, Inc., Amber-Booth, or equal make.

2.2 VIBRATION ISOLATORS

A. Description of Work.
1. Provide a complete vibration isolation system for certain equipment, where specified, to isolate motorized equipment from the building structure and ceiling construction.

B. Quality Assurance: Vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier.

C. Manufacturers: Kinetics Noise Control, Amber Booth, Mason Industries, Inc., Peabody, or approval equal manufacturer.

D. Preparation
1. Steel components shall be phosphated and painted. All nuts, bolts, and washers shall be zinc-electroplated.
2. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.
3. All isolators exposed to the weather shall have steel parts PVC coated or hot-dip galvanized.

E. Installation
1. Equipment: All motorized equipment including pumps, fans, and other equipment, shall be mounted on, or suspended with, vibration isolators.
2. The installed vibration isolation system for each floor or ceiling supported equipment shall have a maximum lateral motion under equipment start up or shut down conditions of 1/4 inch. Motions in excess shall be restrained by approval spring type thrust restraints as approved by submittal drawing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Equipment: All motorized equipment including pumps, fans, and other equipment, shall be mounted on, or suspended with, vibration isolators.

B. The installed vibration isolation system for each floor or ceiling supported equipment shall have a maximum lateral motion under equipment start up or shut down conditions of 1/4 inch. Motions in excess shall be restrained by approval spring type thrust restraints as approved by submittal drawing.

C. Examine areas and equipment to receive vibration isolation for compliance with requirements for installation tolerances and other conditions affecting performance.

D. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

E. 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 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 forces.

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.

3.3 VIBRATION-CONTROL AND RESTRAINT DEVICE INSTALLATION

A. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

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 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless 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.

3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

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.

END OF SECTION 23 05 48

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.
6. Valve tags.
7. 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. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 TAGGING

A. All new controlling valves shall be identified with numbered 2" diameter brass tags attached to valve wheels or stems with heavy brass chains. Tags shall have stamped letters, to designate piping system, and numbers, i.e., - heating H-1, chilled water CH-1, etc.

B. The contractor shall prepare a printed chart, designating the location and briefly stating the function of each valve so marked, properly classified and placed in numerical order. The chart shall also contain complete instructions for the operation of the circulating system and component parts. Copy of chart shall be submitted to the Engineer for proofreading and approval. Approved copy of chart and instructions to be mounted and set in frame under glass and hung in mechanical equipment room. Bind a copy with each set of instructions to be furnished under the General Conditions.

2.2 PIPING IDENTIFICATION

A. The contractors shall include identification of all piping installed under their respective contracts. Such identification shall be in the form of stenciling.

B. Underground piping shall be marked with a continuous, underground type plastic line marker.

C. Contents of piping shall be identified within 3 feet of each valve, or near each branch. All piping shall be identified along pipe runs at not more than 25 foot intervals where piping is concealed and 50 foot intervals where piping is exposed.

D. Identification of all other pipe shall be made in the form of stenciling by applying one heavy coat of enamel and shall consist of identifying name in lettering at least 1" high, 8" long directional arrow below name, and a 2-1/4" wide band consisting of three 3/4" wide bands of different painted colors encircling pipe on each side of name and arrow. In addition, for insulated piping, identifying name shall also identify insulation type. Name, arrow, and bands for the same piping system contents shall be of same colors; colors to be used for various systems shall be as directed by the Engineer.

E. Piping contents shall be labeled as follows:

Type of Service	Color: Bands, Arrows & Lettering	Designation
Drain	Gray	DR
Chilled Water	Black	CW (1)
Gas Piping	Yellow	G

F. Notes: (1) Add suffix for supply “S” or return “R”

G. All underground pipe shall be marked with a continuous, underground-type plastic line marker. confirm location of markers with the Engineer.

2.3 HVAC DUCTWORK IDENTIFICATION

A. Provide plastic laminate or stenciled signs and arrows, in black or white (whichever provides most contrast with the ductwork color).

B. The following ductwork shall be identified:
   1. Supply
   2. Return
   3. Exhaust
   4. Intake

C. Location: Where ductwork is exposed, concealed by removable ceiling tiles, at duct origin, prior to concealed areas, and at 50 ft. intervals along exposed runs.

D. Access Doors: Provide stenciled or plastic laminate signs: including purpose and other appropriate maintenance, operating, safety and procedural information.

E. Concealed Doors: Provide stenciled or plastic signs.

F. Location of markers: Confirm with Engineer.

G. Submit sample of all signage to the Engineer for approval.

2.4 EQUIPMENT IDENTIFICATION

A. Contractors shall include identification of all equipment installed under their respective contracts.

B. Identification shall be on the form of a plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, in accordance with UC master equipment numbering scheme (APPA).

C. The following equipment shall be identified:
   1. Control System Panels and Major Devices
   2. Major heat transfer equipment: chillers, pumps, cooling towers, and similar equipment
   3. HVAC air handling unit
   4. Special components that may need regular maintenance or require awareness during trouble-shooting functions. Submit sample to the Engineer for approval.

D. Submit sample to the Engineer for approval. In first paragraph below, describe required label content. The objective of labeling equipment is to coordinate it with Drawings, including plans, details, and schedules. This will allow other information, such as capacities and operating characteristics, to be obtained.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

END OF SECTION 23 05 53

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SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Balancing Air Systems:
      a. Constant-volume air systems.
   2. Balancing Hydronic Piping Systems:
      a. Constant-flow hydronic systems.
      b. Variable-flow hydronic systems.
      c. Primary-secondary hydronic systems.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 60days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. Certified TAB reports.

E. Sample report forms.

F. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by NEBB.
   1. TAB Field Supervisor: Employee of the TAB contractor and certified by NEBB
   2. TAB Technician: Employee of the TAB contractor and who is certified by NEBB as a TAB technician.

B. TAB Conference: Meet with Engineer and Commissioning Agent on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.
   1. Agenda Items:
      a. The Contract Documents examination report.
      b. The TAB plan.
      c. Coordination and cooperation of trades and subcontractors.
      d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard TAB contractor's forms approved by Engineer and Commissioning Agent.

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 PROJECT CONDITIONS

A. 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. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 GENERAL

A. Provide equipment for testing, including necessary pumps, air compressors, hoses, gages, etc. Make necessary temporary connections to perform testing. Test piping systems before insulation and control devices are installed wherever feasible. Tests shall be performed before any work is concealed, covered, or painted.

B. Preliminary testing using air may be performed by the contractor to void delays in filling and draining of system for repairs. However, final test shall be hydrostatic unless specified otherwise.

C. A test fails if a leakage is observed or if the pressure drop exceeds 5% of test pressure over the duration of specified time.

D. Repair pipe or fittings which fail required test, by disassembly and reinstallation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

E. After successful, final test, which must be witnessed by the Owner, Owner's Representative or Engineer, drain all water from system.

F. Hydrostatic tests shall be maintained for a minimum of eight (8) hours; air tests shall be maintained for a minimum of twenty-four (24) hours.

G. Water Systems. All other hydronic piping shall be tested and made tight initially under air pressure and then under hydrostatic pressure each equal to 1-1/2 times the working pressure but in not case less than 125 PSI.

H. Steam and Condensate Piping. Steam and condensate piping shall be tested same as Water Systems.

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.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums used for return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.
   1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
   2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

L. Examine control valves for proper installation for their intended function of diverting or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:
   1. Permanent electrical-power wiring is complete.
   2. 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 NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
   1. Comply with requirements in ASHRAE 62.1-2010, "Air Balancing."

B. If necessary, cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
   1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
   2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
   3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) 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 outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.5 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 total airflow.
      a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
   2. Measure fan static pressures as follows to determine actual static pressure:
      a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
      b. Measure static pressure directly at the fan outlet or through the flexible connection.
      c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
      d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
   3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
      a. Report the cleanliness status of filters and the time static pressures are measured.
   4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
   5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
   6. Obtain approval from Engineer and Commissioning Agent for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
   7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
   1. Measure airflow of submain and branch ducts.
      a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
   2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
   3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.
   1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
   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 minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
   1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
   2. Select the terminal unit or unit zone 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 or unit zone is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
   3. Measure total system airflow. Adjust to within indicated airflow.
   4. Set terminal units or zones at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
   5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
      a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
   6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
      a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
   7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
   8. Record final fan-performance data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
   1. Open all manual valves for maximum flow.
   2. Check liquid level in expansion tank.
   3. Check makeup water-station pressure gage for adequate pressure for highest vent.
   4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
   5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
   6. Set system controls so automatic valves are wide open to heat exchangers.
   7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
   8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
   1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
      a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Engineer and Commissioning Agent and comply with requirements in Division 23 Section "Hydronic Pumps."
   2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
      a. Monitor motor performance during procedures and do not operate motors in overload conditions.
   3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
   4. Report flow rates that are not within plus or minus 10 percent of design.

B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

D. Set calibrated balancing valves, if installed, at calculated presettings.

E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
   1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
   1. Determine the balancing station with the highest percentage over indicated flow.
   2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
   3. Record settings and mark balancing devices.

H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

J. Check settings and operation of each safety valve. Record settings.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.10 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first and then balance the secondary circuits.

3.11 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
   1. Manufacturer's name, model number, and serial number.
   2. Motor horsepower rating.
   3. Motor rpm.
   4. Efficiency rating.
   5. Nameplate and measured voltage, each phase.
   6. Nameplate and measured amperage, each phase.
   7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.12 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:
   1. Entering- and leaving-water temperature.
   2. Water flow rate.
   3. Water pressure drop.
   4. Dry-bulb temperature of entering and leaving air.
   5. Wet-bulb temperature of entering and leaving air for cooling coils.
   6. Airflow.
   7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:
   1. Nameplate data.
   2. Airflow.
   3. Entering- and leaving-air temperature at full load.
   4. Voltage and amperage input of each phase at full load and at each incremental stage.
   5. Calculated kilowatt at full load.
   6. Fuse or circuit-breaker rating for overload protection.

3.13 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 5 percent.
   2. Air Outlets and Inlets: Plus or minus 5 percent.
   3. Cooling-Water Flow Rate: Plus or minus 5 percent.

3.14 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare weekly progress 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.

3.15 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
   1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
   2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:
   1. Pump curves.
   2. Fan curves.
   3. Manufacturers' test data.

4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Center-to-center dimensions of sheave, and amount of adjustments in inches.

j. Number, make, and size of belts.
k. Number, type, and size of filters.

2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
   g.
3. Test Data (Indicated and Actual Values):
   a. Total air flow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Filter static-pressure differential in inches wg.
   f. Preheat-coil static-pressure differential in inches wg.
   g. Cooling-coil static-pressure differential in inches wg.
   h. Heating-section static-pressure differential in inches wg.
   i. Outdoor airflow in cfm.
   j. Return airflow in cfm.
   k. Outdoor-air damper position.
   l. Return-air damper position.
   m. Vortex damper position.

F. Apparatus-Coil Test Reports:
   1. Coil Data:
      a. System identification.
      b. Location.
      c. Coil type.
      d. Number of rows.
      e. Fin spacing in fins per inch o.c.
      f. Make and model number.
      g. Face area in sq. ft.
      h. Tube size in NPS.
      i. Tube and fin materials.
      j. Circuiting arrangement.
   2. Test Data (Indicated and Actual Values):
      a. Air flow rate in cfm.
      b. Average face velocity in fpm.
      c. Air pressure drop in inches wg.
      d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
      e. Return-air, wet- and dry-bulb temperatures in deg F.
      f. Entering-air, wet- and dry-bulb temperatures in deg F.
      g. Leaving-air, wet- and dry-bulb temperatures in deg F.
      h. Water flow rate in gpm.
      i. Water pressure differential in feet of head or psig.
      j. Entering-water temperature in deg F.
      k. Leaving-water temperature in deg F.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:
   1. Fan Data:
      a. System identification.
      b. Location.
      c. Make and type.

d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
   g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
   a. Total airflow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Suction static pressure in inches wg.

H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
   a. System and air-handling-unit number.
   b. Location and zone.
   c. Traverse air temperature in deg F.
   d. Duct static pressure in inches wg.
   e. Duct size in inches.
   f. Duct area in sq. ft.
   g. Indicated air flow rate in cfm.
   h. Indicated velocity in fpm.
   i. Actual air flow rate in cfm.
   j. Actual average velocity in fpm.
   k. Barometric pressure in psig.
   l.

I. Air-Terminal-Device Reports:
1. Unit Data:
   a. System and air-handling unit identification.
   b. Location and zone.
   c. Apparatus used for test.
   d. Area served.
   e. Make.
   f. Number from system diagram.
   g. Type and model number.
   h. Size.
   i. Effective area in sq. ft.
2. Test Data (Indicated and Actual Values):
   a. Air flow rate in cfm.
   b. Air velocity in fpm.
   c. Preliminary air flow rate as needed in cfm.
   d. Preliminary velocity as needed in fpm.
   e. Final air flow rate in cfm.
   f. Final velocity in fpm.
   g. Space temperature in deg F.

J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
   1. Unit Data:
      a. System and air-handling-unit identification.
      b. Location and zone.
      c. Room or riser served.
      d. Coil make and size.
      e. Flowmeter type.
   2. Test Data (Indicated and Actual Values):
      a. Air flow rate in cfm.
      b. Entering-water temperature in deg F.
      c. Leaving-water temperature in deg F.
      d. Water pressure drop in feet of head or psig.
      e. Entering-air temperature in deg F.
      f. Leaving-air temperature in deg F.

3.16 INSPECTIONS

A. Initial Inspection:
   1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
   2. Check the following for each system:
      a. Measure airflow of at least 10 percent of air outlets.
      b. Measure water flow of at least 5 percent of terminals.
      c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
      d. Verify that balancing devices are marked with final balance position.
      e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:
   1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Commissioning Agent and Engineer.
   2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Commissioning Agent and Engineer.
   3. Commissioning Agent and Engineer shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
   4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
   5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
   1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
   2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.17 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 05 93

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SECTION 23 07 00 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Insulation Materials:
      a. Glass Fiber.
      b. Foamed Plastic.
      c. Foam Glass
   2. Fire-rated insulation systems.
   3. Insulating cements.
   4. Adhesives.
   5. Mastics.
   6. Lagging adhesives.
   7. Sealants.
   8. Factory-applied jackets.
   9. Field-applied cloths.

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. Shop Drawings:
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail attachment and covering of heat tracing inside insulation.
   3. Detail insulation application at pipe expansion joints for each type of insulation.
   4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   5. Detail removable insulation at piping specialties, equipment connections, and access panels.
   6. Detail application of field-applied jackets.
   7. Detail application at linkages of control devices.
   8. Detail field application for each equipment type.

C. Qualification Data: For qualified Installer.

D. 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.

E. 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 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.

B. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.8 APPLICATION OF INSULATION

A. No insulation shall be applied until pipe work has been tested for tightness and approved by the Engineer. In case insulation is damaged due to leaks in pipe work which has not been tested for tightness, this contractor shall remove all such damaged insulation and all additional insulation necessary to replace the defective pipe work. He shall then replace new insulation at his own expense after pipe work has been repaired.

B. All pipe insulation shall be installed continuous through floor, walls, partitions, and roof. In case pipe sleeves are not of sufficient size to permit the continuous application of insulation, the contractor for the piping installation will do all necessary cutting.

C. In case piping or ductwork is installed at an insufficient distance from walls, other pipe, ductwork, or other obstructions to permit application of full thickness of insulation, the contractor for the piping or ductwork installation will relocate piping to permit application of full thickness of insulation.

D. All hanger rods must be perpendicular to piping before pipe insulation is applied.

E. Where clevis hangers are installed outside insulation; provide 12" long section of foamglass insulation at each hanger the same thickness as the adjoining insulation; also refer to Section on Supports.

F. In applying insulation, the sections shall be butted tightly together to provide effective insulation and exclude air where condensation must be avoided.

G. Existing insulation cut or damaged in the course of the work under this contract shall be repaired in kind.

1.9 FIRE SAFETY

A. All insulation, jackets, tapes, vapor barriers, adhesives, etc. shall be fire-safe (flame spread rating of 25 or less, fuel contribution rating of 35 or less, and smoke developed rating of 50 or less). All adhesives used and required in the application of pipe covering and insulation shall be Benjamin Foster, or equal adhesives, applied per the manufacturer's recommendations for the specific application. All insulating materials, adhesives, jackets, etc. shall be of approved non-combustible or flame retardant type complying with the Local and State Basic Building Codes and N.F.P.A. Bulletin No. 90A.

1.10 FIRESTOPPING

A. All insulated piping which penetrates walls, floors, and/or roofs with a fire-resistive rating shall be insulated with molded foamglass "ASJ-SSL" covering, including a dual purpose fireproof, kraft aluminum foil laminated (white) jacket. Insulation shall be the same thickness as the adjoining insulation. Foamglass shall be installed and sealed as hereinafter specified.

1.11 INSULATION COVER

A. Stainless Steel Jacket: Exposed exterior pipe insulation where directed and within manhole shall be covered with a 0.016" thick stainless steel jacket, sealed with Dow Corning No. 999 silicone (aluminum color to match jacket) and secured with stainless steel rivets installed 6" on center.

B. Lagging Cloth Cover: Exposed pipe and duct insulation inside the building shall be finished with a rewettable glass lagging cloth fabric 14.3 oz. per square yard applied over vapor barrier jacket, tightly stretched and pasted on with Benjamin Foster, or equal fire-safe adhesive, or equal cement. Seams in jacket shall be made on top of pipes or toward the wall in such a manner as to make them as inconspicuous as possible. The covering and jacket adjacent to flanges shall be applied in such a manner as to give access for wrenches on bolt heads and

nuts when plastic covering is removed. Covering in shafts and covering above suspended ceilings will NOT be considered exposed.

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.

2.2 DUCTWORK INSULATION

A. The contract shall include all items of labor and materials required for the complete installation of the duct insulation work as shown on accompanying drawings and hereinafter specified. The following ducts shall be insulated (except ducts with sound insulation as hereinafter specified):
   1. All new conditioned supply air ducts.
   2. All new conditioned return air ducts.
   3. All new exhaust air ducts from automatic control damper to exhaust opening.
   4. All new outdoor air ducts.
   5. Provide sound insulation for certain ducts as indicated on drawings.
   6. Existing ductwork insulation cut or damaged in the course of the work under this contract.

B. Thermal Insulation For All Exposed Ducts
   1. Glass Fiber Duct Insulation
      a. Rectangular and Round Ducts: All duct shall be insulated on the outside with Johns-Manville "Micro-Lok", Owens Corning ASJ, Knauf, Certainteed, or equal, 1-1/2" thick fiberglass insulation in one piece molded sections with foil kraft universal fire-resistive and vaporseal jacket. Insulation shall be applied with kraft foil vapor barrier jacket. The longitudinal seams shall be held together tightly by stapling the jacket overlaps with outward-clinch staples 3" on center; the overlap shall be coated with a vapor barrier adhesive before stapling. End joints shall be tightly butted and covered with factory furnished vapor barrier tapes, heavily coated with vapor barrier adhesive, the ends of the tape overlapped and held securely with outward-clinch staples. Staples to be coated with vapor barrier adhesive. Ends of insulation shall be sealed off with vapor barrier adhesive or mastic. All fittings shall be insulated with fabricated mitered segments of the same fiberglass insulation with joints butted firmly together and sealed with 3" wide vapor sealing tape. In some cases at the contractor’s option, certain rectangular insulated ducts shall be insulated on the outside with Johns-Manville Type 815FF, Owens Corning, Certainteed, or Knauf, 1-1/2" rigid, 3 lb. density fiberglass board, tightly secured

with sheet metal washers and screws or weld pins 12" to 18" on centers. On cold ducts, all joints shall be sealed with 3" wide vaporsealing tape.

b. Jacket: Refer to Section 23 07 00, Paragraph 1.11.

C. Thermal Insulation for all Concealed Ducts (Exterior of Ductwork)

1. Glass Fiber Duct Insulation

a. All concealed insulated ducts in vertical shafts, crawl spaces, and/or above suspended ceilings shall be insulated with 1-1/2" thick, 3/4 lb. density fiberglass blanket insulation with aluminum foil skrim kraft vaporseal on the outside and with all joints taped with vapor barrier plastic tape.

D. Sound Insulation

1. Where shown, as hereinbefore specified, and as detailed on the drawings, ducts shall be sound insulated on inside with 1" thick, non-combustible AP Armaflex SA self-adhering close-cell elastomeric sheet. The sections shall be butted tightly together to provide effective insulation and to prevent condensation. Should condensation appear on ductwork with internal lining, the contractor shall repair or replace insulation or shall provide external duct insulation. For lined ducts, dimensions of duct shown on drawing is dimension inside sound lining.

2.3 HVAC EQUIPMENT INSULATION

A. General

1. The contract shall include all items of labor and materials required for the complete installation of the equipment insulation work as shown on accompanying drawings and hereinafter specified, including the following principal items:

a. Chilled water pumps and chilled water strainers.

B. Strainers

1. All strainers at pumps, equipment, valves, etc. shall be insulated so that insulation can be removed for the cleaning of the screens and replaced without damage to the insulation.
2. Furnish insulated sheet metal caps or formed plastic caps over ends of strainers, held in place with removable steel bands around body of strainer.

2.4 PIPING INSULATION

A. General

1. The contract shall include all items of labor and materials required for the complete installation of the pipe insulation work as shown on accompanying drawings and hereinafter specified, including the following principal items:

a. All new chilled water supply and return piping.

b. Existing pipe insulation cut or damaged in the course of work under this contract.

2. Fittings: Fittings, flanges, etc. shall be insulated with fabricated mitered segments of insulation equal in thickness to the insulation on adjoining pipe. Fittings 3" and smaller may be insulated with insulating cement of equal thickness. Insulation on fittings shall be cement smooth. Expansion joints shall be wrapped with glass blanket compacted to the thickness of the adjoining pipe, wired in place with No. 20 gauge copper wire, and triple wrapped with 2" wide polyvinyl tape. Insulation on fittings shall be cement smooth.
3. Valves, Strainers, etc. shall be insulated with a removable insulating cover consisting of a fibrous insulation material encased in a silicone integrated fiberglass cloth cover with stainless steel lacing hooks. Blanket shall be double sewn lock stitch with cloth binding. Blanket overlap shall be 2" minimum. A stainless steel identification plate shall be riveted to each blanket piece.

4. Jackets: Refer to section 23 07 00, Paragraph 1.11.

B. Insulation Of Piping at Fire Resistive Walls and Floors and Chilled Water Piping
   1. All insulated piping which penetrates walls and floors with a fire-resistive rating and chilled water piping installed within the building shall be insulated as follows:
      a. Foam Glass Pipe Insulation
         1) Insulation shall be molded foamglass Pittsburgh Corning “ASJ-SSL” covering, including a dual purpose fireproof, kraft aluminum foil laminated (white) jacket. Insulation shall be coordinated properly with paragraph heading “Pipe Hangers and Supports” and shall be continuous through hanger rings. Insulation for chilled water supply and return piping shall be 1-1/2” thick for up to 4” pipe and 2” thick for larger pipe sizes; insulation for insulated piping penetrating walls and floors with fire resistive rating shall be the same thickness as the adjoining insulation.
         2) Adjoining sections shall be butted firmly together and the longitudinal lap of the vapor barrier jacket shall be sealed with the white flamesafe vapor barrier lap cement. End joints shall be sealed with factory-furnished 3” vapor barrier strips applied with flamesafe lap cement. Bands shall be applied over edges of joint seal strips and at center of each section of insulation.
         3) Fittings: All fittings shall be insulated with preformed sectional foamglass units, mechanically secured and spiral wrapped with special vaporsealing tape with white exterior surface; all valve bodies, flanges, special fittings, etc. shall be insulated with a fiberglass blanket compacted to the thickness of the covering, and spiral wrapped with special vaporsealing tape; covering shall butt tightly to and tape shall overlap the foamglass. Exposed fittings insulated with fiberglass shall have an additional layer of insulating cement troweled smooth.
         4) Jackets: Refer to Section 23 07 00, Paragraph 1.11.

C. Insulation Of Chilled Water Piping Within Air Handling Unit
   1. Foamed Plastic Insulation:
      a. Pipe: Insulation shall be 1” thick Armstrong “FR-Armaflex”, Rubatex, or IMCOA Polyolefin flexible foamed plastic, fire-retardant, closed cell, ozone resistant pipe insulation. At hangers, insulation shall be installed as detailed on drawing, shall be properly coordinated with paragraph heading “Pipe Hangers and Supports”, and shall be continuous through hanger rings and supports. Adjoining sections and any longitudinal joints shall be butted firmly together and cemented with Armstrong No. 520 adhesive.
      b. Fittings: All fittings shall be insulated with fabricated mitered segments of the same foamed plastic pipe insulation with joints butted firmly together and cemented with Armstrong No. 520 adhesive.
      c. Jackets: Refer to Paragraph 1.11.

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. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of 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 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
1. Comply with requirements in Division 07 Section "Penetration Firestopping".

F. Insulation Installation at Floor Penetrations:
1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and

replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric 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.

3.6 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 23 07 00 O:\MCEProjects\Xu\XU2014.04 (Training Addition)\CD Spec\230700_fl.doc

SECTION 23 08 00 – COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to Section 01 91 13 “Commissioning” for all specific requirements required associated with the commissioning process that will be required as part of this work. As part of this project, participation in the commissioning process as described in Section 01 91 13 shall be required.

1.2 SUMMARY

A. Section includes commissioning process requirements for HVAC systems, assemblies, and equipment.

B. Related Sections:
1. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.

1.3 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CxA: Commissioning Authority.

C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.

D. DDC: Direct Digital Controls.

E. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 ALLOWANCES

A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Division 01 Section "Allowances."

1.5 UNIT PRICES

A. Commissioning testing allowance may be adjusted up or down by the "List of Unit Prices" Article in Division 01 Section "Unit Prices" when actual man-hours are computed at the end of commissioning testing.

1.6 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase HVAC and Integrated Automation coordination meetings.

C. Attend testing, adjusting, and balancing review and coordination meetings.

D. Participate in HVAC systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

E. Provide information requested by the CxA for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.7 CxA'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing, adjusting, and balancing of Work are complete.

D. Provide test data, inspection reports, and certificates in Systems Manual.

1.8 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:
   1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
   2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
   3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC systems, assemblies, equipment, and components to be verified and tested.
   4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
   5. Certificate of readiness certifying that HVAC systems, subsystems, equipment, and associated controls are ready for testing.
   6. Test and inspection reports and certificates.
   7. Corrective action documents.
   8. Verification of testing, adjusting, and balancing reports.

1.9 SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

1.10 COMMISSIONING AUTHORITY

A. Motz Engineering acting in conjunction with Xavier University Maintenance Personnel will take the role of the Commissioning Authority for this project. The Commissioning Authority will respond to all issues directly to the Owner and shall have the authority to grant final acceptance of each system commissioned.

1.11 COMMISSIONING PLAN

A. This section and sections in other Divisions shall outline the work required for the project, consistent with the Commissioning Plan. Any discrepancies between the Commissioning Plan and the Project Manual sections shall be brought to the attention of the Commissioning Agent for clarification.

1.12 COORDINATION

A. The General Contractor and appropriate Subcontractors shall be responsible for cooperating and coordinating their work during the installation and commissioning process. Refer to the specific requirements and other sections for required work associated with coordination of installation work and preparation of Coordination Construction Drawings by the contractors.

B. The Commissioning Authority will participate in the coordination of installation work as necessary to insure the installation of system components meet the Owner's project requirements and will provide a facility that has appropriate access and means for future maintenance and service by Owner.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Certify that HVAC systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that HVAC instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 TESTING VERIFICATION

A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.

C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC systems at the direction of the CxA.
   1. The CxA will notify testing and balancing Subcontractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
   2. The testing and balancing Subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
   3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
   4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of HVAC testing shall include entire HVAC installation.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. Tests will be performed using design conditions whenever possible.

E. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

F. The CxA may direct that set points be altered when simulating conditions is not practical.

G. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

H. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

I. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. The following systems shall be commissioned:
1. HVAC systems including:
a. Direct digital automatic temperature control system.
b. Air distribution systems (air handling unit).
c. Hot water heating system.
d. Chilled water system.
e. Exhaust systems.
f. Unitary equipment (unit heaters).

END OF SECTION 23 08 00

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SECTION 23 11 23 – NATURAL GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Pipes, tubes, and fittings.
   2. Piping specialties.
   3. Piping and tubing joining materials.
   4. Valves.

1.3 DESCRIPTION OF SYSTEM

A. Extend new gas piping to new boiler.

1.4 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.

1.5 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:
   1. Piping and Valves: 100 psig minimum unless otherwise indicated.
   2. Service Regulators: 65 psig minimum unless otherwise indicated.
   3. Minimum Operating Pressure of Service Meter: 5 psig.

1.6 SUBMITTALS

A. Product Data: For each type of the following:
   1. Piping specialties.
   2. Valves. Include pressure rating, capacity, settings, etc.
   3. Dielectric fittings.

4. Mechanical sleeve seals.
5. Escutcheons.

B. Shop Drawings: For natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, and attachments of the same to building structure. Detail location of anchors, alignment guides, etc.
1. Shop Drawing Scale: 1/4 inch per foot.
2. Detail mounting, supports, and valve arrangements for service meter assembly and pressure regulator assembly.

C. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

D. Welding certificates.

E. Field quality-control reports.

F. Operation and Maintenance Data: For pressure regulators and service meters to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. 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.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

1.9 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
   1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
   2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
   3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
   4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
      a. Material Group: 1.1.
      b. End Connections: Threaded or butt welding to match pipe.
      c. Lapped Face: Not permitted underground.
      d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
      e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
   5. Mechanical Couplings:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Dresser Piping Specialties; Division of Dresser, Inc.
         2) Smith-Blair, Inc.
      b. Steel flanges and tube with epoxy finish.
      c. Buna-nitrile seals.
      d. Stainless-steel bolts, washers, and nuts.
      e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
      f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.

2.2 PIPING VALVES & SPECIALTIES

A. Furnish and install all valves and specialties where shown or required for the proper operation of the system.
   1. At each piece of equipment: Provide a lubricated plug cock.
   2. At each low point in piping: A 6" long drip pocket consisting of pipe the same size as the riser, capped at the bottom.
   3. Valves shall always be placed in accessible positions for operation and repairs.

2.3 JOINING MATERIALS

A. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 DIELECTRIC FITTINGS

A. Refer to Section 23 05 00.

2.5 SLEEVES

A. Refer to Section 23 05 00.

2.6 MECHANICAL SLEEVE SEALS

A. Refer to Section 23 05 00.

2.7 ESCUTCHEONS

A. Refer to Section 23 05 00.

2.8 GROUT

A. Refer to Section 23 05 00.

2.9 LABELING AND IDENTIFYING

A. Refer to Section 23 05 00.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

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

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 requirements for prevention of accidental ignition.

3.3 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. 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.

F. Locate valves for easy access.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Verify final equipment locations for roughing-in.

J. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
   1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

K. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

L. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

M. Connect branch piping from top or side of horizontal piping.

N. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

O. Do not use natural-gas piping as grounding electrode.

P. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

3.4 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas connection.

3.5 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:
   1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.

2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. 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.

D. Welded Joints:
1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

3.7 CONNECTIONS

A. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

B. Install piping adjacent to appliances to allow service and maintenance of appliances.

C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.8 LABELING AND IDENTIFYING

A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 23 11 23

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SECTION 23 21 11 - PIPING MATERIALS

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 a summary of all Piping Materials related work:

B. Related Sections:
1. 23 21 13 – HYDRONIC PIPING

1.3 CHILLED WATER PIPING

A. 2-1/2" and Larger.
1. Pipe: Standard, A-53 black steel.
2. Fittings: Standard, butt-weld.

B. 2" and Smaller.
1. Pipe: Type “L” copper tubing, hard temper.
2. Fittings: Solder end, cast red brass or wrought copper.

1.4 DRAIN PIPING

A. Copper Piping.
1. Pipe: Type "L" copper tubing, hard temper.
2. Fittings: Solder end, cast red brass or wrought copper.

PRODUCT DATA SHEET 1 - PART 2 – PRODUCTS – (NOT USED)

PRODUCT DATA SHEET 2 - PART 3 – EXECUTION – (NOT USED)

END OF SECTION 23 21 11

SECTION 23 21 13 – HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
   1. Chilled-water piping.
   2. Air-vent piping.

B. Related Sections include the following:
   1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.3 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding minimum working pressure and temperature specified herein:

1.4 SUBMITTALS

A. Product Data: For each type of the following:
   1. Pressure-seal fittings.
   2. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
   3. Air control devices.
   4. Hydronic specialties.
   5. Chemical treatment.
   6.

B. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Welding certificates.

D. Qualification Data: For Installer.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:
1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
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.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

1.6 EXTRA MATERIALS

A. Water-Treatment Chemicals: Furnish enough chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. All pipe and fittings shall be of the best of their respective kinds as hereinafter specified and shall at all times meet the approval of the Engineer.

B. Where certain pipe is mentioned hereinafter in any part of the specification, such pipe shall conform to the requirements of the designated pipe under this title "Pipe and Fittings".

C. Standard specifications hereinafter referred to as "ASTM" are the specifications of the American Society for Testing Materials, together with existing addenda thereto. All references shall include subsequent revisions of said specifications.

D. All pipe shall be subjected at the manufacturer's works to a hydrostatic pressure test and only pipe which is tight and undistorted when subjected to such a test shall be used. All threaded pipe shall be delivered with couplings or sleeve pieces to protect threads from damage.

E. All work, whether shown on the drawings or specified, shall be installed in an approved manner to meet the structural and architectural conditions and to avoid interference insofar as possible with the work of other Mechanical or Electrical Contractors, all subject to the approval of the

Engineer. Special care shall be taken in the arrangement of piping to secure a neat and workmanlike appearance and true alignment and grade. All pipe and fittings shall be thoroughly cleaned before erection, removing all scale, burrs, fins, and obstruction. All pipe shall be thoroughly reamed, and ample provision must be made to allow for expansion of piping without undue strain. All piping shall be sloped approximately 1" in 30'-0" to eliminate air and facilitate drainage.

2.2 COPPER PIPE

A. Copper Tubing and Fittings shall be Anaconda, Chase, Mueller, Revere, or equal, Type K or Type L as hereinafter specified, 99.9% pure copper tubing complying with ASTM Specification B-88, Type K or Type L. All tubing shall be hard temper. All fittings in copper tubing shall be Mueller Brass Co., or equal, cast red brass fittings, containing not less than 85% copper, with soldered ends, or wrought copper fittings with soldered ends, and designed for 150 PSI (steam) and 300 PSI (water) pressure. All soldered joints shall be wiped smooth. 2-1/2" and larger flanged copper fittings shall be used at equipment and valves. All joints and fittings shall comply with the latest edition of ASME Code for Pressure Piping.

B. Drain Piping: Fittings in copper, drain, waste, and vent lines shall be cast or wrought D.W.V. copper fittings with soldered ends. All joints shall be soldered in accordance with the recommendations and standards of the manufacturer for not less than 150 PSI and 250E service, using lead free nickel solder.

C. Water Piping: All soldered joints shall be soldered for 150 PSI, 250E service, in accordance with the recommendations and standards of the manufacturer, using approved lead-free nickel silver solder.

2.3 BLACK STEEL PIPE

A. Black Steel Pipe shall be scale free steel pipe of soft weldable steel, of uniform quality, and manufactured in accordance with ASTM Standard Specification; 1-1/2" and smaller pipe shall be butt-welded steel pipe Serial Designation A-53; larger pipe shall be seamless steel or electric resistance welded steel pipe Serial Designation A-53, Grade B. Where hereinbefore specifically specified or indicated, pipe shall be ASA Schedule 80; pipe 12" and larger shall have 0.500" wall thickness. All other piping shall be as follows: pipe 10" nominal and smaller in size shall be ASA Schedule 40; pipe 12" and larger shall have 0.375" wall thickness. Nipples and couplings shall be same composition and weight. The manufacturer's mark and date shall be plainly embossed on each mill length and nipple. All joints and fittings shall comply with latest edition of ASME Code for Pressure Piping.

B. Threaded Pipe: Threads shall be accurately cut; all screwed joints shall be made tight with red lead and oil compound or Teflon tape applied to male threads only, and all pipe shall be reamed. Screwed fittings shall be of Crane, Grinnell, Walworth, or equal make, with perfect taper right hand threads, with heavy bead, smooth inside and out, and new. Where changes in pipe sizes occur in horizontal lines, eccentric fittings shall be used. Screwed couplings shall be same make as pipe and shall be of standard length and thickness for weight of pipe used. Threads shall all be right hand. Screwed fittings shall have the following pressure ratings:

C.

PRESSURE RATINGS	LIQUID AND GAS @ 150° F.

Cast Iron Class 125	175 PSI
Cast Iron Class 250	400 PSI
Malleable Iron Class 150	300 PSI
Malleable Iron Class 300	Min. 1000 PSI

D. Buttweld Pipe joints shall be single vee, butt type, fabricated by the fusion welding oxy-acetylene or electric welding process using high test welding rod or by semi-automatic metal arc welding machines using micro-wire in accordance with Procedure No. 25 of the National Certified Pipe Welding Bureau. All welding shall be done by properly certified and competent welders in a thorough and workmanlike manner and shall be fabricated in accordance with the ASME and Heating and Piping Contractors National Association Welding Specifications. Note: Extra precautions shall be taken to control fire hazards during welding and to protect adjoining surfaces, glass, etc. from hot sparks or similar damage. Bends, 90E ells, etc. shall be made with Tube Turns, Crane, Grinnell, or equal, welding fittings of the same material as the pipe. Branches in straight pipe shall be made with welding tees of same make and specification as elbows, except branches one-fourth the size of the main and less may be made with welding neck flanges or Weld-O-Let, or equal fittings; approved Thread-O-Let fittings may be used for small pipes where specified with screwed joints. Elbows shall be of long radius pattern. The use of elbows and fittings fabricated by welders at the site or the use of couplings for branch connections will not be permitted.

E. Flanged Pipe connections to flanged valves, regulators, and equipment, fittings shall be made through Tube Turn weld neck flanges or cast iron flanged fittings of Crane, Grinnell, Walworth, or equal make, of 125-150 lbs. standard, except 250-300 lbs. extra heavy flanges or fittings with high tensile strength bolts shall be used where valves or equipment are regularly furnished with extra heavy flanges in lieu of standard flanges. All flanged joints shall be made up with Sur-seal Type NA-700 gaskets for water and Sur-graph gaskets for steam, using bolts with standard cold punched hexagon nuts. After system has been operated, the bolts of all flanged joints shall be tightened.

F. Socket Weld Pipe joints shall be socket welded using 2000 lb. socket welding steel fittings. All bends, 90E ells, etc. shall be made with Tube Turns, Crane, Grinnell, or equal, socket welding fittings. Branches in straight pipe shall be made with welding tees of same make and specification as elbows. Elbows shall be of long radius pattern. The use of elbows and fittings fabricated by welders at the site or the use of couplings for branch connections will not be permitted.

G. Socket Weld Pipe joints shall be socket welded using 2000 lb. socket welding steel fittings. All bends, 90° ells, etc. shall be made with Tube Turns, Crane, Grinnell, or equal, socket welding fittings. Branches in straight pipe shall be made with welding tees of same make and specification as elbows. Elbows shall be of long radius pattern. The use of elbows and fittings fabricated by welders at the site or the use of couplings for branch connections will not be permitted.

2.4 VALVES

A. Refer to Section 23 05 00.

2.5 AIR CONTROL DEVICES

A. Refer to Section 23 05 00.

2.6 HYDRONIC PIPING SPECIALTIES

A. Refer to Section 23 05 00.

2.7 CHEMICAL TREATMENT

A. Refer to Section 23 25 00.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Refer to Section 23 21 11.

3.2 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

B. Install throttling-duty valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such 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. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

U. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.4 HANGERS AND SUPPORTS

A. Refer to Section 23 05 29.

3.5 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

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/D10.12M, 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-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
   4. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

K. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.

D. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above the floor. Install feeder in minimum NPS ¾ bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS ¾ pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.

E. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
   1. Install tank fittings that are shipped loose.
   2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

F. Install expansion tank on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.7 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:
   1. Leave joints, including welds, uninsulated and exposed for examination during test.
   2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
   4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
   5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:
   1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
   2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
   3. Isolate expansion tanks and determine that hydronic system is full of water.
   4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum

yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."

5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:
1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13

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SECTION 23 21 14 - HOT WATER HEATING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF SYSTEM

A. Rework certain building and underground hot water piping to accommodate improvements associated with this project.

B. The existing hot water system consists of a two-pipe forced circulating system. The system shall be expanded as indicated on the drawings.

1.3 HOT WATER PIPING SYSTEM EQUIPMENT

A. New Hot Water Pumps: Refer to Section 23 21 23.

B. New Expansion Tank: Refer to Section 23 05 17.

C. New Heating Coils on Air Handling Unit: Refer to Section 23 73 13.

1.4 VALVES AND SPECIALTIES

A. Furnish and install the valves and specialties as indicated on the drawings.

B. All control valves, etc. to be furnished by the Building Automation Contractor as hereinafter specified.

C. In branch piping at high points of the system: 1/8" manual air vent cocks.

D. In the mains at high point of system: Anderson, Crane, Fischer, 1/2" automatic air vent traps with cast iron body and bronze float and valve mechanism, and with discharge piped to floor drain.

E. At all low points of piping: A drain valve with hose fitting capped.

1.5 CONNECTIONS

A. Furnish and install the following valves and specialties:
   1. At new hot water heating coils at existing air handling unit (Alternate Bid):
      a. In supply connection to hot water heating coil: A butterfly valve, strainer, and ¾" drain valve with hose fitting capped.

b. In return connection to hot water heating coil: A butterfly valve and ¾" drain valve with hose fitting capped.
c. In return connection from the hot water heating coil: An automatic two-way water valve, furnished by Building Automation Contractor, as hereinafter specified.

1.6 INSTRUMENTS

A. Furnish and install the following instruments:
1. In hot water supply and return piping: Wells furnished by the Building Automation Contractor.
2. In the piping, 1/2" pressure-temperature test plugs at the following locations for use with gauges and thermometers specified in Section 23 05 19:
a. At inlet and outlet of each air handling unit.

PRODUCT DATA SHEET 1 - PART 2 – PRODUCTS – (NOT USED)

PRODUCT DATA SHEET 2 - PART 3 – EXECUTION (NOT USED)

END OF SECTION 23 21 14

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SECTION 23 21 15 - CHILLED WATER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF SYSTEM

A. Rework certain underground chilled water piping to accommodate site improvements associated with this project.

B. The existing chilled water system within the building consists of a two-pipe forced circulating system with two existing variable speed building chilled water pumps, and a supply and return piping system to circulate chilled water from the campus Central Refrigeration Plant to the cooling coils in new air conditioning units and to return chilled water to the campus Central Refrigeration Plant. This system shall be expanded to serve the Phase 3 portion of the building.

1.3 CHILLED WATER SYSTEM EQUIPMENT

A. New Cooling Coils in Air Handling Unit: Refer to Section 23 73 13.

1.4 CONNECTIONS

A. Furnish and install the following valves and specialties:
   1. At chilled water cooling coils at each new Air Handling Unit:
      a. In supply connection to the bank of chilled water cooling coils: A butterfly or ball valve, strainer, and 3/4" drain valve with hose fitting capped.
      b. In return connection from chilled water cooling coil: A butterfly or ball valve and 3/4" drain valve with hose fitting capped.
      c. In return connection from chilled water cooling coil: An automatic two-way chilled water valve, furnished by Building Automation Contractor, as hereinafter specified.
      d. In inlet to each coil: A ball valve, 3/4" drain valve, and a flange.
      e. In outlet of each coil: A calibrated balancing valve, air vent, a ball valve, and a flange.
   2. In new supply and return mains to each new air handling unit: A butterfly valve.
   3. In chilled water supply and return mains to each new air handling unit: A differential pressure transmitter.
   4. In branch piping, where shown, and at high points of the system: One 1/8" manual air vent cock.
   5. In the mains at high points of the system: One Anderson, Crane, Fischer, Hoffman, or equal, 1/2" automatic air vent trap with cast iron body and bronze float and valve mechanism, and with discharge piped to floor drain except at fan coil units air vent discharge shall be piped to fan coil unit drain.
   6. Where shown, and at all low points of piping: A 3/4" drain valve with hose fitting capped.

1.5 INSTRUMENTS

A. Furnish and install the following instruments:
   1. In the suction and discharge piping at each pump: One (1) pressure gauge. Refer to Paragraph 23 05 19.
   2. In the piping at the inlet and outlet of evaporator: One (1) 9" industrial stem thermometer. Refer to Paragraph 23 05 19.
   3. In chilled water supply and return piping: Wells furnished by Building Automation Contractor.
   4. In chilled water supply and return piping: One (1) valve outlet for Building Automation Contractor's pressure sensors.
   5. In the piping, 1/2" pressure-temperature test plugs at the following locations as specified in Paragraph 23 05 19:
      a. At inlet of coil.
      b. At outlet of coil.
      c. At inlet and outlet of strainer at coil.
      d. At inlet and outlet of new temperature control valve at new coil.

1.6 VALVES AND SPECIALTIES

A. Furnish and install valves and specialties as indicated on the drawings.

B. All chilled water control valves, etc. to be furnished by the Building Automation Contractor.

C. In branch piping, where shown, and at high points of the system: One (1) 1/8" manual air vent cock.

D. In the mains at high points of the system: One (1) 2" automatic air vent with discharge piped to floor drain. Refer to Section 23 05 19.

E. Where shown, and at all low points of piping: A 3/4" drain valve with hose fitting capped.

PRODUCT DATA SHEET 1 - PART 2 – PRODUCTS – (NOT USED)

PRODUCT DATA SHEET 2 - PART 3 – EXECUTION – (NOT USED)

END OF SECTION 23 21 15

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SECTION 23 25 00 - HVAC WATER TREATMENT

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 HVAC water-treatment systems:
   1. HVAC water-treatment chemicals.
   2. Cleaning and Testing Hydronic Piping System.

1.3 DEFINITIONS

A. EEPROM: Electrically erasable, programmable read-only memory.

B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

C. TDS: Total dissolved solids.

D. UV: Ultraviolet.

E. AABC: Associated Air Balance Council.

F. NEBB: National Environmental Balancing Bureau.

G. TAB: Testing, adjusting, and balancing.

H. TABB: Testing, Adjusting, and Balancing Bureau.

I. TAB Specialist: An entity engaged to perform TAB Work.

1.4 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform pressure tests on water distribution systems have been satisfactorily completed.

1.5 TESTING

A. Provide equipment for testing, including necessary pumps, air compressors, hoses, gages, etc. Make necessary temporary connections to perform testing. Test piping systems before insulation and control devices are installed wherever feasible. Tests shall be performed before any work is concealed, covered, or painted.

B. Preliminary testing using air may be performed by the contractor to void delays in filling and draining of system for repairs. However, final test shall be hydrostatic unless specified otherwise.

C. A test fails if a leakage is observed or if the pressure drop exceeds 5% of test pressure over the duration of specified time.

D. Repair pipe or fittings which fail required test, by disassembly and reinstallation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

E. After successful, final test, which must be witnessed by the Owner, Owner's Representative or Engineer, drain all water from system.

F. Hydrostatic tests shall be maintained for a minimum of eight (8) hours; air tests shall be maintained for a minimum of twenty-four (24) hours.

G. Water Systems: All HVAC hydronic piping shall be tested and made tight initially under air pressure and then under hydrostatic pressure each equal to 1-1/2 times the working pressure but in not case less than 125 PSI.

1.6 PERFORMANCE REQUIREMENTS

A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.

B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

C. Closed hydronic systems, including hot-water heating and chilled water, shall have the following water qualities:
   1. pH: Maintain a value within 9.0 to 10.5.
   2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
   3. Boron: Maintain a value within 100 to 200 ppm.
   4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
   5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
   6. TDS: Maintain a maximum value of 10 ppm.
   7. Ammonia: Maintain a maximum value of 20 ppm.
   8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
   9. Microbiological Limits:
      a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
      b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.
      c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
      d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
      e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.

1.7 SUBMITTALS

A. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit cleaning and testing strategies and step-by-step procedures as specified in "Preparation" Article.

B. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:
   1. Bypass feeders.

2. Chemical test equipment.
3. Chemical material safety data sheets.

C. Shop Drawings: Pretreatment and chemical**,** treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.

D. Field quality-control test reports.

1.8 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

B. All cleaning and flushing of piping shall be scheduled in advance with the Owner and the Commissioning Agent in order that they can witness the process.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aqua-Chem, Inc.; Cleaver-Brooks Div.
2. GE Betz.
3. HVC Chemical.
4. Dow Chemical.
5. Industrial Water Solutions.

2.2 CLEANING

A. All piping systems must have been satisfactory tested before systems are cleaned. Also, before any system is placed in service and before start-up of any equipment, each contractor shall clean piping, fixtures, and equipment installed under their respective contracts, and shall remove other foreign matter detrimental to the operation of the system.

B. All Water Systems shall be thoroughly washed out with treated water until the systems are clean and passivated and free of all scale, dirt, weld beads, solder, or other deleterious matter. The contractor shall provide the following chemicals or approved equals:

C. Water Systems – H. D. Cleaner Model No. 203

D. All strainers shall then be cleaned.

E. Flush lines utilizing temporary water pumps as required. Contractor to finish an ultra fine strainer for pumps. Contractor shall also provide all temporary valved by-passes to be installed in the piping as required to circulate cleaners.

2.3 CHEMICAL FEEDERS

A. Provide necessary temporary chemical feeders to install water treatment chemicals.

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 cleaning and testing of systems.

B. Examine system installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

C. Report deficiencies discovered before and during performance of cleaning and painting procedures. Observe and record system reactions to changes in conditions.

3.2 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

END OF SECTION 23 25 00

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SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

B. Related Sections:
1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2010.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:
1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:
1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.

6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, restraints, and vibration isolation.

C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Perimeter moldings.
    g. AV/IT Equipment.

D. Welding certificates.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2010, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2010, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 RECTANGULAR LOW PRESSURE SUPPLY DUCTS AND ALL RETURN AND EXHAUST DUCTS

A. Rectangular low pressure supply ducts including ducts on discharge of terminal units, and all return and exhaust ducts shall be fabricated from AK Steel, or equal, galvanized iron or steel sheets. Ducts shall conform with all SMACNA Duct Construction Standards for Gauge and Reinforcement for 2" pressure class.

2.2 ROUND DUCTS

A. Round ducts shall be United Sheet Metal, Semco, or equal, galvanized steel spiral ducts and shall conform to SMACNA duct construction standards.

2.3 STAINLESS STEEL DUCTS

A. Where indicated on the drawings, within 18" of outdoor air louvers, ducts shall be constructed of 304-2B stainless steel with mill finish and shall conform to the following schedule:

Width in Inches
Up to 30"

B. Joints: All joints and seams shall be continuously soldered with stainless steel solder and made watertight. Longitudinal seams shall be on top side of horizontal ducts.

2.4 FLEXIBLE DUCTS

A. Round ducts to air outlets shall include a minimum 1'-0" long section of flexible duct. In areas where insulated ductwork is specified, flexible ducts shall be Clevepak Corp. Cleveflex Type 12FV, Thermaflex M-KC, United, Wiremold, or equal insulated flexible tubing. All other flexible ducts shall be Clevepak Corp. "Cleveflex" Type 12, Thermaflex S-TL, United, Wiremold, or equal, flexible tubing. Tubing shall be flame-resistant and shall comply with the latest requirements of NFPA Bulletin No. 90A.

B. Joints: All joints shall be secured with adjustable clamp or metal strap with sheet metal screw, sealed with approved duct sealer, and taped with polyvinyl tape while sealer is wet.

2.5 SPECIAL WORK

A. Where necessary, sheet metal work shall be specially built to suit structural conditions, as where beams or other steel passes through ducts, offsets are necessary to avoid work of other trades, to avoid other ducts, to provide proper head room, or to install the ducts in the space available. Such special work shall be part of the contract and shall be done without extra cost to the Owner.

2.6 CASINGS

A. At outdoor air intake plenums for certain new air handling units where shown on the drawings, construct casings as shown. Support casing on concrete curb formed and poured by the HVAC Contractor. Each casing shall be constructed to the dimensions shown and shall be of self-supporting type consisting of prefabricated insulated steel panels forming a complete enclosure on top, bottom, sides, and ends. Panels shall consist of 2" thick, Schuller "Spin-glas" No. 815, 3 lb. density insulation (or equivalent insulation of Owens Corning or Pittsburgh manufacture), encased in inner and outer galvanized sheet steel shells of not less than No. 22 U. S. gauge, except interior of outdoor air intake plenum within 5 feet of louver shall be constructed from No. 20 gauge, 304-28 mill finished stainless steel. Outer shell and inner face shall be adequately braced and stiffened to form a self-supporting structure of neat appearance. Junction posts between panels, corner posts, etc. shall be formed of not less than No. 18 U.S. gauge sheet steel, and panels shall be suitably secured to posts. Each entire assembly shall be gasketed or caulked to be essentially airtight at 4" H20 pressure difference. Access doors shall be 24" x 48" (unless otherwise shown), of similar construction, except sheet steel door panels shall be not less than No. 20 U.S. gauge. Doors shall be set in suitably reinforced frames, and shall be fitted with refrigerator type gaskets and pressure type hinges and door handles, similar to that manufactured by The Cincinnati Refrigerator Hardware Company or approved equal and with provisions for operating from either side of door. Submit complete shop drawings showing details of construction for approval.

2.7 BLANK-OFF PANELS

A. Behind a portion of louvers, where indicated, construct prefabricated, insulated blank-off panels the full size of the masonry opening and consisting of 2" thick Schuller "Spin-glas" No. 815, 3 lb. density insulation (or equivalent insulation of Owens Corning or Pittsburgh manufacture), encased in inner and outer sheet steel shells of not less than No. 22 U.S. gauge. Outer shell and inner face shall be adequately braced and stiffened to form a self-supporting structure of neat appearance. Face adjacent louver shall be stainless steel; face exposed inside building shall be galvanized steel.

B. Each panel shall be gasketed and/or caulked to louver frame, shall be held in place by a continuous 1-1/2" x 1-1/2" x 1/4" angle secured to building masonry opening and blank-off panel and/or plate, and shall be airtight.

2.8 SUPPORTS

A. All horizontal rectangular and round ducts up to 25" in width shall be supported on not more than 7'-0" centers by means of pairs of 1/4" rod or 1/8" x 1" band hangers attached to a horizontal angle on the bottom of the duct. All other rectangular ducts 25" to 47" in width shall be supported on not more than 4'-0" intervals from 1/4" diameter rods and ducts larger than 47" in width shall be supported on not more than 4'-0" intervals from 3/8" diameter rods, attached to the stiffening angles hereinbefore specified.

B. Under concrete construction, hangers shall be supported by Rawl, Hilti, or approved equal expansion bolts installed per manufacturer's installation instructions and load ratings (with 5:1 safety factor) and placed horizontally in side of concrete fire proofing where possible and installed in concrete slabs at other locations.

C. In certain areas, hangers shall be supported by concrete inserts, Grinnell Fig. 282, Fee and Mason or Gateway, malleable iron body and nut.

D. Adjacent to concrete and block construction, hangers shall be supported by Rawl or Hilti expansion bolts installed per manufacturer's installation instructions and load ratings (with 5:1 safety factor).

E. Under bar joist construction, hangers shall be supported by beam clamps, Grinnell Fig. 218, Fee and Mason, or Gateway malleable iron jaws with steel rod and nut. Where intermediate support between beams is required, contractor shall weld angle iron supports between beam or bar joists, top of angles being level with top of building steel.

F. Under steel beam construction, hangers shall be supported by beam clamps, Grinnell Fig. 218, Fee and Mason, or Gateway malleable iron jaws with steel rod and nut. Where intermediate support between beams is required, contractor shall weld angle iron supports between beam or joists, top of angles being level with top of building steel.

G. Ductwork shall not be supported from ceiling grid, raised floor, electrical conduit, heating or plumbing lines, or any other utility lines, and vice versa. Each utility and the raised floor system shall be a separate installation and each shall be independently supported from the building structure - concrete, steel, or masonry. Where interferences occur, in order to support ductwork, piping, conduit, ceiling grid systems, etc., trapeze type hangers or supports shall be employed and shall not be located where they interfere with access to fire dampers, valves, etc.

H. All vertical ducts shall be supported on each floor level by means of the angle iron stiffeners and at intermediate points where required for rigidity.

I. Hangers used on ducts shall be galvanized iron hangers of approved type.

J. Hangers and supports shall support and brace the ducts in such a manner that the ducts will be absolutely rigid.

K. Ductwork shall be free from vibration when the systems are in operation and any ductwork having excessive vibration shall be provided with additional supports or braces at no extra cost.

L. Any cutting and patching required to install hanger supports shall be performed by this contractor. Patching work shall match and shall be integral with surrounding surfaces.

2.9 SIZES AND SHAPES

A. Dimensions of the ducts shown on the plans shall not be considered as absolute, but any change from same shall be subject to the approval of the Engineer.

B. Where, on account of obstructions, or for other reasons, it is necessary to change the shape of the ducts shown, equivalent areas shall be maintained. In no case, however, shall areas be reduced without special permission of the Engineer.

2.10 HOLES FOR DUCTS

A. Where any new ductwork or piping is shown through existing walls, the HVAC Contractor shall make such new openings in existing walls/partitions. The HVAC Contractor shall provide lintels in accordance with the general lintel schedule indicated on the Architectural drawings.

B. New HVAC openings in existing floors shall be performed by the HVAC Contractor unless otherwise noted. Coordinate with structural drawings.

C. New HVAC openings in existing roofs shall be performed by the roofing contractor. The HVAC Contractor shall layout the various openings with the roofing contractor and coordinate the exact locations. The roofing contractor will cut the openings, provide any structural members needed, and close up the opening with the necessary roofing materials.

D. New HVAC openings in new walls, new roofs, new floors, shall be closely coordinated with the General Trades Contractor. For new openings in new walls, the HVAC Contractor coordinate the location of the desired opening, shall provide a lintel to the General Trades Contractor, and shall ultimately close up around the opening once the new ductwork is installed. For new openings in new floors and roofs, the HVAC Contractor shall layout the exact location of the opening with the General Trades Contractor. The General Trades Contractor will box out and frame around the opening and provide all requisite concrete and/or structural related work. The HVAC Contractor shall provide final close up, fireproofing, etc. of this opening.

E. All penetrations made by the HVAC Contractor in acoustical rated walls/partitions or floors shall be sealed by the HVAC Contractor.

F. All holes for ductwork shall be sealed airtight to duct to maintain integrity of ceiling or floor plenum.

G. Patching work shall match and shall be integral with existing surrounding surfaces.

H. In fire rated walls, space between bare ductwork or insulation and hole shall be filled with fire barrier products. The HVAC Contractor shall provide all requisite firestopping for their ductwork and piping at penetrations and joints.

2.11 LINTELS AND SLEEVES

A. This contractor shall provide suitable wall frames for all new wall openings for ducts and fire dampers in new and existing walls, and General Trades Contractor will set and brick up and patch around same. Thoroughly caulk any void between duct and opening through which duct and/or sleeve passes so as to make airtight and waterproof with fire-resistive rating equal to or greater than the construction penetrated. Provide sheet plates on both sides of wall covering opening. The HVAC Contractor shall provide all requisite firestopping for their ductwork and piping at penetrations and joints.

B. Where this contractor provides openings in any masonry walls, he shall provide lintels for openings greater than 15" wide; lintels shall be 12" longer than opening to provide 6" bearing on each side, and shall be of the following sizes: For 16" to 36" opening, 4" x 3" x 1/4"; for 37" to 48" opening, 4" x 3" x 5/16"; for 49" to 60" openings, 5" x 3" x 5/16"; for 61" to 72" opening, 5" x 3" x 3/8"; for 73" to 84" openings, 5" x 3" x 1/2"; for 85" to 96" openings, 6" x 3-1/2" x 3/8". Note, refer to lintel schedule shown on Architectural drawings as well. The more stringent requirement shall govern.

2.12 ACCESS DOORS

A. Access doors shall be provided in the duct system and in casings where shown or where required. Doors shall be provided for access to the fresh air inlets, to both sides of filter banks,

to inlet and discharge of all fans, to both sides of coils, for all air operated dampers, to all volume dampers in exposed ductwork, for all fire dampers, and to the base of all vertical flues where same are accessible. Walk-in doors in air unit casings shall be constructed of same material as hereinbefore specified; other walk-in doors shall be the pan type, viz. double thickness galvanized No. 20 gauge, with double offset hinges, refrigerator gaskets, and pressure type hardware (two per door) as made by The Cincinnati Refrigerator Hardware Company. These doors shall be approximately 48" x 24". Reach-in doors for access to air operated dampers, fan discharge, etc. shall be the pan type as above, size approximately 18" x 18" with two window fasteners for catches. Doors for access to hand operated volume dampers shall be handhole sliding type, size approximately 6" x 9". All doors shall be made tight. Provide access doors in horizontal ducts for cleaning ductwork, located approximately 20'-0" on centers; grilles will be counted as access doors.

2.13 ACCESS PANELS

A. Where equipment requiring operation or maintenance occurs in inaccessible locations, such as above unaccessible suspended ceilings, behind walls, etc., access panels shall be provided. Where access panels are not indicated on architectural drawings, this contractor shall furnish and install flush metal access panels with frames of ample size for removal or repair of such equipment. Where removable ceiling panels occur, access panels will not be required.

B. Access doors shall be Milcor, or equal, of the following types: in plaster walls: Style DW; in masonry walls: Style M; in plaster and drywall ceilings: Style AP; in inaccessible acoustical ceilings: Style AT. Doors in fire rated walls shall have a fire rating equal to or greater than the wall.

2.14 BALANCED BACKDRAFT DAMPERS

A. Furnish and install new balanced backdraft dampers where specifically indicated on the drawings and herein specified. Damper frame shall be extruded aluminum with a wall thickness of .090". Damper blades shall also be extruded aluminum with a wall thickness of .050" and equipped with a vinyl blade edge seal.

B. Balanced backdraft dampers shall be Ruskin Model No. BD2A1, Prefco, Air Balance, Louvers and Dampers, or approved equal.

2.15 DAMPERS

A. A volume damper shall be provided in each main low pressure duct before any branches are taken off and in each main branch and in each individual connection to a supply or exhaust air opening. Dampers in individual branches shall be back of grilles. Where registers are shown or specified at air openings they shall take the place of the volume damper. Volume dampers back of grilles shall be held in place by a friction device and they shall be arranged for adjustment from inside the room without removing the grille. All other volume dampers shall be provided with approved indicating and locking devices located in accessible places.

2.16 AUTOMATIC DAMPERS

A. The contractor shall install all automatic dampers furnished by the Integrated Automation Contractor, including outdoor air dampers, return air dampers, and exhaust air dampers.

2.17 FIRE DAMPERS

A. Furnish and install all fire dampers as shown on the drawings and required by Bulletin No. 90A and No. 101 of the Regulations of the National Fire Protection Association and National Board of Fire Underwriters. Approved fire dampers shall be installed at all points where ducts pass through masonry shaft construction and fire walls; or at structural floors if ducts are exposed. All dampers at these locations shall be constructed and installed to provide the same hourly fire rating as the construction. Special attention shall be given to the method of mounting the dampers; dampers shall be installed in accordance with SMACNA standards so they will remain in place even though the ducts are melted away by fire. Clear openings through dampers shall be not less than the size of duct to which damper is connected. Provide access doors near each damper. The contractor shall submit drawings to the Engineer showing the location and construction of all fire dampers.

B. Fire dampers shall be Air Balance, Airstream Products, Ruskin, Prefco, Safe Air, Louvers & Dampers, or equal, Underwriters Labelled fire dampers of required size; such dampers shall be built into the construction as hereinbefore specified.

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 23 Section "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.

9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 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 (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "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.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:
   a. Ducts with a Pressure Class Higher Than 2-Inch wg: Test representative duct sections, selected by Architect from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.
3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:
   1. Visually inspect duct system to ensure that no visible contaminants are present.
   2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
      a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 23 31 13

SECTION 23 34 16 - CENTRIFUGAL HVAC FAN

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. Ceiling mounted, circulation fan furnished with standard mounting hardware and variable speed control.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan performance ratings on actual Project site elevations above sea level.

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.

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 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. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

D. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Certifications
   1. The fan assembly, as a system, shall be ETL-certified and built pursuant to the guidelines set forth by UL standard 507 and CSA standard 22.2 No. 113.
   2. The fan shall be compliant with NFPA 13 – Standard for the Installation of Sprinkler Systems, NFPA 72 – National Fire Alarm and Signaling Code, and NFPA 70 – 2011 – National Electric Code (NEC).
   3. Controllers shall comply with National Electric Code (NEC) and Underwriters Laboratory (UL) standards and shall be labeled where required by code.

B. Manufacturer Qualifications
   1. The fan and any accessories shall be supplied by Big Ass Fan Company that has a minimum of ten (10) years of product experience.
   2. ISO 9001 – certified.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to the 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 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.8 WARRANTY

A. The manufacturer shall replace any products or components defective in material or workmanship for the customer free of charge (including transportation charges within the USA, FOB Lexington, KY), pursuant to the complete terms and conditions of the Big Ass Fans Non-Prorated Warranty in accordance to the following schedule:

Airfoils	Lifetime (Parts)
Hub	Lifetime (Parts)
Motor	15 years (Parts)
Gearbox	15 years (Parts)
Light Kit	5 years (Parts)
Controller	15 years (Parts)
All other fan components	15 years (Parts)
Labor	1 year (Parts)

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Delta T Corporation, dba Big Ass Fans.

2.2 HIGH VOLUME, LOW SPEED FANS – BIG ASS FANS POWERFOIL®X2.0

A. Complete Unit
1. Regulatory Requirements: The entire fan assembly (without light kit) shall be ETL-certified and built pursuant to the construction guidelines set forth by UL standard 507 and CSA standard 22.2.
2. Sustainability Characteristics: The fan shall be designed to move an effective amount of air for cooling and destratification in a variety of applications (including industrial and agricultural) over an extended life. The fan components shall be designed specifically for high volume, low speed fans to ensure lower operational noise. Sound levels from the fan operating at maximum speed measured in a laboratory setting shall not exceed 55 dBA. Actual results of sound measurements in the field may vary due to sound reflective surfaces and environmental conditions.
3. Good workmanship shall be evident in all aspects of construction. Field balancing of the airfoils shall not be necessary.

B. Onboard Fan Control
1. The onboard fan controller shall be constructed using a variable frequency drive (VFD) that is pre-wired to the motor and factory-programmed to minimize the starting and breaking torques for smooth and efficient operation. The onboard controller shall be prewired to the motor using a short run of flexible conduit with a dedicated ground conductor to minimize electromagnetic interference (EMI) and radio frequency interference (RFI). A 15-ft incoming power cord shall be pre-wired to the controller with one of the following plugs: NEMA L6-20P Twist-Lock Plug, NEMA L6-30P Twist-Lock Plug, NEMA L15-20P Twist-Lock Plug, NEMA L16-20P Twist-Lock Plug.

C. Airfoil System
1. The fan shall be equipped with ten (10) Powerfoil airfoils of precision extruded aluminum alloy. The airfoils shall be connected by means of two (2) high strength locking bolts per airfoil. The airfoils shall be connected to the hub and interlocked with zinc plated steel retainers.
2. The fan shall be equipped with ten (10 Powerfoil winglets on the ends of the airfoils and ten (10) AirFences™ positioned on the airfoils at the optimum location for performance. Both the winglet and Airfence shall be molded of polypropylene. The standard color of the winglet and AirFence shall be “Safety Yellow.”

D. Motor
1. The fan motor shall be an AC induction type inverter rated at one of the following:
a. 1725 RPM, 200-250/400-480 VAC, 50/60 Hz, three-phase.
2. The motor shall be totally enclosed, fan cooled (TEFC) with an IP42 NEMA classification. A NEMA 56C standard frame shall be provided for ease of service. The motor shall be manufactured with a double baked Class F insulation and be capable of continuous operation in -30°F to 122°F (-34°C t0 50°C) ambient conditions.

E. Gearbox
1. The fan gearbox shall be a NitroSeal™ Drive designed specifically for the Powerfoil X2.0. The gearbox shall include a high-efficiency, hermetically sealed, nitrogen-filled, offset helical gear reducer with two-stage gearing, a 2-1/2" (6.4 cm) hollow output shaft, cast iron housing, double lip seals, high quality SKF Explorer Series bearings with crowned cages for optimal lubrication flow, and precision machined gearing to maintain backlash less than 11 arc-minutes over the life of the unit. Lubrication shall be high-grade, low-foaming synthetic oil with extreme pressure additives and a wide temperature range.
2. The gearbox shall be equipped with a hollow shaft threaded to accept a ¾" NPT fitting in which wiring, piping, etc., can be routed to below the fan. A standard junction box can be affixed to this hollow shaft to allow for installing optional features such as lights or cameras. The inclusion of the hollow shaft shall be apecified at the time of order.

F. Mounting Post
1. The fan shall be equipped with a mounting post that provides a structural connection between the fan assembly and extension tube. The mounting post shall be formed from A36 steel, contain no critical welds, and be powder coated for corrosion resistance and appearance.

G. Mounting System
1. The fan mounting system shall be designed for quick and secure installation on a variety of structural supports. The mounting yoke shall be of welded construction and made from low carbon A36 steel no less than 3/16" (0.5 cm) thick, per ASTM A36, and be powder coated for appearance and resistance to corrosion. No mounting hardware substitutions, including cast aluminum, are acceptable.
2. All mounting bolts shall be SAE Grade 8 or equivalent.

H. Hub
1. The fan hub shall be made of precision cut aluminum for high strength and light weight. The hub shall consist of two (2) aluminum plates, ten (10) aluminum spars and one (1) aluminum spacer fastened with a pin and collar rivet system.
2. The hub shall be secured to the output shaft of the gearbox by means of ten (10) high strength bolts. The hub shall incorporate five (5) safety retaining clips made of ¼" (0.6 cm) thick steel that shall restrain the hub/airfoil assembly.

I. Safety Cable
1. The fan shall be equipped with a safety cable that provides an additional means of securing the fan assembly to the building structure. The safety cable shall be 3/8" (1 cm) diameter and fabricated out of 7 x 19 zinc galvanized steel cable. The end loops shall be secured with swaged Nicropress® sleeves, pre-loaded and tested to 3,200 lbf (13,345 N).
2. Field construction of safety cables is not permitted.

J. Wall control
1. The fan is equipped with a wall control providing 100% control of all fan functions. The wall control shall be a digital keypad device mounted within a cast zinc cover. The cover shall be capable of mounting to a standard switch box.
2. Equipped with touchpad controls and an LED display for controlling the fan's direction, operation, speed, and programming. Communication between the fan VFD and wall control is by a standard CAT5 (or higher) Ethernet cable. The wall control comes standard with 150 ft of factory-assembled CAT5 Ethernet cable.
3. Equipped with a simple diagnostic program to identify faults in the system. Provisions shall be made for retrieving fan operation and diagnostic data (fault messages) through the remote wall control.

K. Fire control Panel Integration

1. Includes a 10-30 VDC pilot relay for seamless fire control panel integration. The pilot relay can be wired Normally Open or Normally Closed in the field.

L. Guy Wires
1. Included for installations with extension tubes 4ft (1.2 m) or longer to limit the potential for lateral movement.

PART 3 - EXECUTION

3.1 PREPARATION

A. Fan location must have a typical bar joist or existing I-beam structure from which to mount the fan. Additional mounting options may be available.

B. Mounting structure must be able to support weight and operational torque of fan. Consult structural engineer if necessary.

C. Fan location must be free from obstacles such as lights, cables, or other building components.

D. Check fan location for proper electrical requirements. Consult installation guide for appropriate circuit requirements.

E. Each fan requires dedicated branch circuit protection.

3.2 INSTALLATION

A. The fan shall be installed by a factory-certified installer according to the manufacturer-s Installation Guide, which includes acceptable structural dimensions and proper sizing and placement of angle iron for bar joist applications. Big Ass Fans recommends consulting a structural engineer for installation methods outside the manufacturer’s recommendation and a certification, in the form of a stamped print or letter, submitted prior to installation.

B. Minimum Distances
1. Airfoils must be at least 10 ft (3 m) above the floor.
2. Installation area must be free of obstructions such as lights, cables, sprinklers or other building structures with the airfoils at least 2 ft (0.61 m) clear of obstructions.
3. The structure the fan is attached to shall be capable of supporting a torque load of up to 300 ft·lb (407 N·m).
4. All HVLS fans shall be interlocked to shut down immediately upon receiving a waterflow signal from the alarm system in accordance with the requirements of NFPA 72 – National Fire Alarm and Signaling Code.

3.3 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 34 16

SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Square ceiling diffusers.
2. Adjustable bar registers and grilles.
3. Fixed face registers and grilles.
4. Egg-crate diffusers and grilles.

B. Related Sections:
1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section "Air 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 type of product indicated, include the following:
1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

E. Source quality-control reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Price Industries.
   b. Titus.
   c. Tuttle & Bailey.
   d. Krueger.
   e. Nailor.
   f. Kees.

2.2 DIFFUSERS

A. All square ceiling supply outlets, designated “S---" and shown square, shall be adjustable ceiling outlets suitable for flush mounting in exposed tee or drywall ceiling and shall be a square panel type with horizontal air pattern and of the capacities shown on the drawings. All 12” x 12” and 24” x 24” outlets shall be Price Architectural Ceiling Diffusers Model SPD with round duct collar, Type 3 for Lay-In or with plaster frame for service mounting (Price TRM). The diffuser shall have a steel face panel that captures a secondary steel panel. The exposed surface shall be smooth, flat and free of visible fasteners. No spot welds or other direct attachments to the face plate are acceptable. Exposed metal parts shall be finished in white No. 26 baked enamel. Certain diffusers, as indicated on the drawings, shall be equipped with an internal fire damper.

B. All square ceiling return, vent, or exhaust outlets, designated “R or E---", shall be similar to “S---" and of the capacities shown on the drawings; Price SPD Model.

2.3 REGISTERS AND GRILLES

A. All wall and duct mounted supply grilles, designated "SG---", shall be Price Model 510S, or equal, heavy gauge aluminum blades with aluminum border, high capacity, industrial type, single deflection grilles, with 3/4" deep extruded aluminum bars spaced 3/4" on center; vertical bars in front; complete with optional, opposed multi-blade locking volume control shutter at rear; grilles shall be 3-7/8" deep for surface mounting on duct with gaskets and drilled holes and mounting screws. Grilles located in walls shall have Titus Type PF, or equal, steel frame. Exposed aluminum portions of wall mounted grilles, flange, and frame shall be finished in white baked enamel equal to Titus No. 26 finish. Duct mounted grilles in utility area shall be finished with lacquer sprayed and baked in aluminum equal to Titus No. 01 finish.

B. All Wall and duct mounted return or exhaust grilles, designated "RG or EG---", shall be Price No. 96L and No. 96S, or equal, 40E single core steel grilles with fixed bars complete with opposed multi-blade locking damper. Grilles located in walls shall have Price Type SPF, or equal, steel frames. Wall mounted grilles, flange, and frame shall be finished in off white baked enamel equal to white finish. Duct mounted grilles shall be finished with lacquer sprayed and baked in aluminum.

C. Certain exhaust or vent grilles and diffusers, designated as egg crate, shall be a Price Model 81D, or equal, all aluminum, egg crate type grille with 1/2" x 1/2" x 1", 90% free area, and 7/8" wide frame. Grille shall be finished in white powder coat. Grille shall be utilized as surface

mount, lay-in, or exposed duct as indicated on drawing. Provide appropriate border for grille type.

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 practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13

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SECTION 23 37 14 - LOUVERS

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. Louvers.

B. Related Sections:
   1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
   2. Division 23 Section "Air 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 type of product indicated, include the following:
   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   2. Louver Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Initial Selection: For louvers with factory-applied color finishes. Custom color to be selected by Architect.

C. Samples for Verification: For louvers, in manufacturer's standard sizes to verify custom color selected.

D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
   1. Method of attaching hangers to building structure.
   2. Duct access panels.

E. Source quality-control reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS OF LOUVERS
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Ruskin
      b. Louvre + Dampers
      c. American Warming

d. Greenheck

2.2 RECTANGULAR LOUVERS

A. This contractor shall furnish and install new outdoor air louver where shown. Each louver shall be of Greenheck**,** Louvre & Dampers, Inc. Type IEL6, American Warming (Model LE-33), or Ruskin manufacture with Type "C" frame and No. 4 sill extension, constructed of 6063-T5 alloy extruded aluminum sections, .08" minimum thickness with 3/8" stainless steel expansion bolts in jambs spaced 2'-0" on center and at top and bottom. Louvers shall be AMCA Certified for air and water penetration. Louvers shall be equipped with aluminum bird screen ½" mesh, 16 gauge aluminum wire in extruded aluminum frame. Screen frame to be securely fastened to inside face of louver. Furnish gaskets for installation between aluminum and dis-similar metals. Furnish and install extruded aluminum closure angles between louvers and other materials if required by drawings, and as required to complete a finished closure between louvers and other materials. All exposed parts of louver sill, bird screen and screen frame shall be finished in a Kynar 500 coating in a custom color selected by Architect. Aluminum surfaces to be in contact with masonry shall be given heavy coat of bituminous paint. Secure louver in openings with adequate anchorage and all surfaces plumb, square and true. Grout under sill. Upon completion, remove all dirt and foreign matter from surfaces and leave louver clean. Caulk around perimeter of louvers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where louvers 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 louvers in strict accordance with the manufacturer’s instructions.

B. Install louvers level and plumb.

END OF SECTION 23 37 13

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SECTION 23 73 13 – MODULAR INDOOR CENTRAL STATION AIR HANDLING UNIT

PART 1 - GENERAL

1.1 BIDDING INFORMATION

A. Furnish and install one (1) air handling unit herein and furnish variable-frequency motor controllers (Section 23 73 14) specified including factory start-up. The variable-frequency motor controllers shall be installed by the Electric Contractor.

B. The air handling unit shall be complete in all details, shall be factory assembled and tested. The HVAC Contractor shall accept air handling unit in Cincinnati, shall deliver air handling unit to the building, shall include in his bid all local freight, hauling and rigging, shall furnish all necessary labor and supervision to erect the equipment on proper foundations and/or supports, and shall perform all field assembly required. Prior to start-up, the air handling unit manufacturer shall confirm that the air handling unit has been accurately assembled and leveled by the HVAC Contractor. After ductwork and water, drain, and vent piping, and electric connections have been made, the air handling unit shall be placed in operation by the manufacturer. The manufacturer shall test and place unit in operation.

C. The start-up of the air handling unit shall be performed by the manufacturer. The mechanic in charge of the crew performing the start-up of the air handling unit shall be factory trained on the type of work to be performed and shall always be present while this work is being performed. All details of construction and installation shall meet the approval of the Engineer. Manufacturer shall provide, in addition, the operating instructions and the equipment operation and performance information as hereinafter specified.

D. The entire installation shall comply with all local laws, laws of the State of Ohio, and the Safety Code of ASHRAE, and the National Electrical Code.

E. The equipment shall comply with the specification herein, shall be the product of a reputable manufacturer, and shall operate at the manufacturer's standard ratings, in all respects. All parts shall be suited to the service and not subject to injury under any condition that may occur in the normal operation of the system.

F. The air handling unit shall be fabricated so that it can be delivered in proper shipping sections to permit entry through openings in the buildings. The HVAC Contractor will be responsible to coordinate shipping sections with the manufacturer.

G. In addition to setting the air handling unit in place, and making requisite piping and ductwork connections thereto, the HVAC Contractor shall be responsible for field installation of the various accessories and miscellaneous components related to the air handling unit, including but not limited to, the following:
   1. Energy Recovery Wheels.
   2. Note, variable-frequency motor controllers shall be installed by the Electric Contractor.

1.2 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 Sections
1. 23 73 14 - Variable-Frequency Motor Controllers

C. Refer to Section 23 73 14. The air handling unit manufacturer shall furnish all variable frequency motor controllers.

1.3 SUMMARY

A. Section Includes:
1. Variable-air-volume, single-zone air-handling unit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design vibration isolation details, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Casing panels shall be self-supporting and capable of withstanding 133 percent of internal static pressures indicated, without panel joints exceeding a deflection of L/200 where "L" is the unsupported span length within completed casings.

1.5 SUBMITTALS

A. Product Data: For the air-handling unit indicated.

1. Unit dimensions and weight.
2. Cabinet material, metal thickness, finishes, insulation, and accessories.
3. Fans:

a. Certified fan-performance curves with system operating conditions indicated.
b. Certified fan-sound power ratings.
c. Fan construction and accessories.
d. Motor ratings, electrical characteristics, and motor accessories.

4. Certified coil-performance ratings with system operating conditions indicated.
5. Dampers, including housings, linkages, and operators.
6. Filters with performance characteristics.

B. Delegated-Design Submittal: For vibration isolation and restraints 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. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

2. Design Calculations: Calculate requirements for selecting vibration isolators for designing vibration isolation bases.

C. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Mechanical-room layout and relationships between components and adjacent structural and mechanical elements.
2. Support location, type, and weight.
3. Field measurements.

D. Source quality-control reports.

E. Field quality-control reports.

F. Operation and Maintenance Data: For the air-handling unit to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2010, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

E. ASHRAE/IESNA 90.1-2007 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2007, Section 6 - "Heating, Ventilating, and Air-Conditioning."

F. Comply with NFPA 70.

G. ETL Compliance: Unit shall be listed and labeled by ETL.

1.7 COORDINATION

A. Coordinate with General Contractor sizes and locations of steel housekeeping curb members, based upon actual equipment provided.

1.8 EXTRA MATERIALS

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

1. Filters: One set(s) for the air-handling unit.
2. Gaskets: One set(s) for each type of access door.
3. Fan Belts: One set(s) for each belt driven air-handling unit fan (if any).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Governair.
2. Mammoth.
3. Miller Picking.
4. Racan.
5. Temtrol.
6. Airflow Equipment, Inc.

B. GENERAL
1. Furnish and install new air handling unit as indicated on the drawings. Provide associated auxiliary equipment for the new system all as hereinafter specified.

C. NEW AIR HANDLING UNIT
1. Furnish and install air handling unit as shown on the drawings and hereinafter specified, consisting of casing, pre-filter, after-filter, heating coils, cooling coils, drip pans, filter gauge, fans, fan drives, motors, bases, heat wheel, dampers, louvers, power connections, etc., all as hereinafter specified. Unit arrangement and dimension shall be as detailed on the drawings.
2. Cabinet and Frame
   a. The unit framework shall be structural, welded heavy gauge steel. All frames shall be fabricated from 11 gauge structural 6" high (min.) steel electrically welded and painted for maximum protection from rust. Lifting lugs shall be provided on the base of the unit for rigging the unit in single piece and shall accept cable or chain hooks.
   b. Decks shall be fabricated from a minimum 14 gauge galvanized steel. Unit shall be 3" double wall construction with a minimum 20 gauge galvanized steel liner. With the exception of the cooling coil discharge section, all unit shall have a perforated liner and mylar coated insulation.
   c. All exterior panels shall be fabricated from a minimum 16 gauge galvanized steel finished with one mil coat of baked acrylic enamel over an epoxy primer. The entire unit will receive a final coat of paint after final assembly to insure complete coverage of exterior panels. Painted finish shall withstand a 500 hour salt spray test. Cabinet panel to be thermal break construction.
   d. Ceiling shall be 2" double wall construction to accept 2-inch fiberglass insulation. Walls and doors shall be 3" double wall construction insulated with 3-inch fiberglass. Insulation in all exterior panels (i.e. roof panels, side and end panels, and doors) will have a minimum R-Value of 13. Underside of deck to be insulated with 4" thick foam insulation (minimum R-valve of 24) with steel under liner.
   e. Hinged access doors shall be complete with tooled latches to provide quick access to service personnel and provide a positive air seal but prevent unauthorized access. Door frames to be thermal break type. Each door shall be equipped with a 12” diameter or a 10” square tempered glass view ports and Durodyne or approved equal IP-4 test port on each door.

f. Dual durometer gasketing to be provided with all access doors. Adhesive-backed gasketing applied to the frame perimeter shall not be acceptable.
g. Hinges shall be of stainless steel with stainless steel pins.
h. Doors shall be complete with locking door retainer to protect doors against damage when open. Hinged access doors shall be provided to the following components: fans, filters, dampers, main control panel, coils and heat wheel.

3. Enathalpy Wheel
   a. Enthalpy wheel shall be ARI Certified and constructed of corrugated and flat aluminum sheet material, treated with a permanent, non-dissolving desiccant appropriate to transfer sensible and latent heats. Desiccant shall be permanently bonded to the matrix material and shall be washable without damage. Rotor shall be constructed so as to only allow straight flow of air through the matrix, parallel to the shaft length. Neither wire mesh, nor any type of hygroscopic fiber, cellulose or plastic is acceptable for rotor media base material. Rotor media air passageways shall permit the passage of particulates up to 300 microns in size. The rotor media shall not have a depth greater than 9 inches nor less than 7 inches. Rotor matrix layers must be corrugated, not dimpled. Unpurgable type rotors are unacceptable.
   b. Energy cassette assembly will include rotor peripheral and divisional seals between the exhaust and make-up air streams. Seals will be non-contact labyrinth seals set to within 1/32" of the rotor surface and designed to operate as linear purges, providing a controlled, positive bleed of air from make-up to exhaust to prevent cross-contamination.
   c. Rotor drive sub-assembly shall incorporate a means for absorbing inertial shock at start and stop of rotation, sufficient to prevent loosening of the drive belt or damage to the gears of the gear reducer.
   d. Rotation shall be at a constant speed, pre-selected by the unit manufacturer to optimize whole unit effectiveness
   e. Frost control shall be means of infrared defrost. Electric pre-heating the exhaust or the make-up may be employed; but any additional cost associated with increased electrical requirements (larger wire, larger circuit breakers, etc. shall be included with unit cost). Rotor RPM speed variation shall not be employed.
   f. The manufacturer shall provide the engineer with satisfactory evidence of independently witnessed wheel performance testing to confirm the manufacturer=s claims for sensible and latent recuperation.
   g. The rotary exchanger cassette shall operate with less than 1% carry over of exhaust (relief) air into the supply (make-up) air, when fitted with a purge angle and properly adjusted fans. The desiccant shall have been tested for collection of gases in any breathable exhaust (relief) air, other than pure water vapor, including ammonia, chlorine, carbon dioxide and methane gas.

4. Coils
   a. General: All coils shall meet or exceed all capacities specified on the mechanical schedule for the project. All water coil performances shall be certified by the manufacturer to be in accordance with ARI Standard 410. Cooling coils shall be mounted in the unit for horizontal air flow. Coil air face velocities shall not exceed the specified velocities of the mechanical schedule. All coils shall be mounted on steel glide channels and fastened to the air seal wall. All coil piping connections to be schedule 40 red brass.
   b. Drain Pans: Entire coil section shall have a pitched drain pan constructed form 16 gauge stainless steel. All corners shall be welded water tight. Drain pan is to be a minimum of 2" deep with a minimum pitch of 1" from high point to drain outlet connection. Coil condensate drain pan shall be completely insulated. If coils are stacked, an intermediate drain pan is required. This intermediate pan shall drain to the bottom main pan. Drain pan will be sloped for positive drainage to eliminate

standing water. The coil main pan shall have a drain extended to the exterior of the air handler.

5. Chilled Water Coils: All hydronic coils shall be tested to 350 psig compressed air under clear water. Coils shall be designed to operate at 250 psig internal pressure and up to 300 F. Internal tubes shall be round seamless 5/8, .035" wall copper tubes which have been deoxidized by the addition of phosphorous. Coil casing shall be constructed of a minimum of 16 gauge continuous stainless steel. Coil casing reinforcements shall be required for fin lengths over 42". Coil fins shall be plate type, die-formed ripple edge corrugated 0.008 aluminum for hot water coils and 0.008 aluminum for chilled water coils with guide channels to create turbulent wiping behind the tubes with collars drawn and belled. Internal copper tubes shall be staggered in direction of air flow. The copper circuiting tubes shall be mechanically expanded to the aluminum copper fins. All hydronic coils shall be drainable with a 0.25" F.P.T. plugged drain or vent tap on the supply and return headers. Seamless copper tubes shall be brazed to the copper supply and return headers. Coils shall be manufactured by air handling unit manufacturer or Aerofin, Marlo, or Heatcraft
6. Duct Furnace:
    a. Duct Furnace shall be indirect fired heating unit having 80% minimum thermal efficiency and incorporating Listed Gas-fired Duct Furnace manufactured by Heatco Inc. or equal. The Duct Furnace shall be listed by Intertek Testing Services (ITS / ETL) for operation on Natural or Propane gas to the current edition of ANSI Z83.8 Standard for Gas-Fired Duct Furnaces. Duct furnaces are for installation on the positive pressure side of the circulating air blower only. The Duct Furnace module shall employ:
        1) A 20 gauge aluminized steel cabinet
        2) 1 inch thick, minimum 1 ½ lb/cu.ft. density thermal insulation for exterior cabinets.
        3) An 18 gauge stainless steel tubular heat exchanger assembly
        4) A combustion blower to provide for positive venting ot flue gases
        5) Air pressure switches to prove air supply for combustion before operation of gas valve
        6) Patented inshot gas burners with integral carryovers
        7) Direct spark ignition of the gas burners with remote flame sensor to prove carryover across all burners
        8) A listed 24 VAC redundant combination gas valve including two electric shut-off valves, gas pressure regulator, and manual shut-off two-stage
        9) An automatic reset type high limit switch to limit maximum outlet air temp to less than 250°F
        10) Manual reset flame rollout switches
        11) A 40 VA, 24 VAC control transformer
        12) A1/8” NPT tapped test gauge connection in the gas manifold for measuring gas pressure
        13) A union fitting downstream of gas control to facilitate installation and service
        14) Provision for attachment of a vent system to exhaust flue gases to outdoors
    b. Gas-fired Duct Furnace shall have a tubular heat exchanger constructed of (Type 304L stainless tubes (0.47 Min. Wall thickness) produced to ASTM A249). Heat exchanger design shall be suitable to withstand 3.0” w.c. total external static pressure without burner flame disturbance.
    c. Duct Furnace modules shall be listed for application downstream of refrigeration and cooling systems and shall provide means for removal of condensate that occurs in the tubes during cooling operation. Heat exchanger tubes shall have (integral formed dimpled restrictors; formed turbulators) to provide for an unobstructed drainage path and tubes shall be formed to provide a positive pitch to

promote condensate drainage. Drainage shall be configured so that burners and burner surfaces are not exposed to condensate.

d. Duct Furnace shall incorporate a Direct Spark Ignition control module that is design certified by a recognized national testing agency. The control shall provide
   1) 100% safety shut-off
   2) A 15 second minimum pre-purge period prior to trial for ignition
   3) High energy direct spark ignition of main burners
   4) Electronic flame supervision incorporating a 0.8 second flame failure response time
   5) Up to 2 additional ignition retrials preceded by an interpurge period
   6) A minimum 30 second post-purge
   7) Automatic reset after one hour to initiate additional ignition trials if lockout occurs during heat call
   8) An alarm capable contact and
   9) An LED indicator light to provide a flash code to identify the operating condition of the control

e. All electrical components shall be listed or recognized by a Nationally Recognized Test Laboratory (ETL, UL, CSA, etc.)

f. Electronic Modulation – Operates from 20 to 100% of input based external analog input of 2 – 10 VDC (supplied by others). Thermostat or heat enable contact (supplied by others) initiates and opens to end heating cycles. Heating unit incorporates variable speed combustion air blower and electronic modulating controller to provide closed loop control of gas and air to maintain constant thermal efficiency of 80% or higher throughout modulating range.

g. Gas supply pressure to the gas valve inlet shall be 5.0” to 13.5” w.c. for Natural Gas.

h. Duct furnaces shall be test fired prior to shipment to verify proper ignition, operation and shut down and satisfactory operation of all components.

i. Burner shall be provided with printed installation and maintenance instructions, burner operating and maintenance instructions, piping and wiring diagrams and Installation Start-up data sheet.

j. A circulating air flow switch (provided by others) to prove that sufficient air flow is present must be installed upstream of heating unit.

7. Supply Fans and Return Fans – Fan Wall Technology (FWT)

a. The Fan Wall System, shall consist of multiple, direct driven, arrangement 4 plenum fans constructed per AMCA requirements for the duty specified, (Class III). All fans shall be selected to deliver the specified airflow quantity at the specified operating Total Static Pressure and fan/motor speed. The Fan Wall Array shall be selected to operate at a system Total Static Pressure that does not exceed 90% of the specified fan’s peak static pressure producing capability at the specified fan/motor speed. Each fan/motor “cube” shall include an 11 gauge, A60 Galvanized steel intake wall, 14 gauge spun steel inlet funnel, and an 11 gauge G90 Galvanized steel motor support plate and structure. The fan intake wall, inlet funnel, and motor support structure shall be powder coated for superior corrosion resistance. All motors shall be standard pedestal mounted type, ODP, T-frame motors selected at the specified operating voltage, RPM, and efficiency as specified or as scheduled elsewhere. All motors shall include isolated bearings or shaft grounding. Each fan/motor cartridge shall be dynamically balanced to meet AMCA standard 204-96, category BV-5, to meet or exceed Grade 0.56 or 0.022 in/sec vibration velocity.

b. The FWT array shall be provided with acoustical silencers that reduce the bare fan discharge sound power levels by a minimum of 15 db re 10-12 watts throughout the eight octave bands with center frequencies of 125, 250, 500, 1000, 2000,

4000, and 8000 HZ when compared to the same unit without the silencers. The silencers shall not increase the fan total static pressure, nor shall it increase the airway tunnel length of the Air Handling Unit when compared to the same FWT unit without the silencer array.

c. Alternate manufacturers must submit acoustical data for review and approval prior to the bid indicating that the proposed alternate equipment can meet all specified performance requirements without impacting the equipment performance or design features including duct connection location, unit weights, acoustical performance, or specified total fan HP for each FWT array. Proposals submitted which indicate a higher connected fan HP than specified or scheduled will not be accepted.

d. The fan array shall consist of multiple fan and motor ”cubes”, spaced in the air way tunnel cross section to provide a uniform air flow and velocity profile across the entire air way tunnel cross section and components contained therein. Each fan cube shall be individually wired to a control panel containing a single VFD, as specified elsewhere, for the total connected HP for all fan motors contained in the FWT array. Wire sizing shall be determined, and installed, in accordance with applicable NEC standards.

e. The Fan Wall array shall produce a uniform air flow profile and velocity profile within the airway tunnel of the air handling unit not to exceed the specified cooling coil and/or filter bank face velocity when measured at a point 12” from the intake side of the Fan Wall array intake plenum wall, and at a distance of 48” from the discharge side of the Fan Wall intake plenum wall.

f. Each fan/motor assembly shall be removable through a 24” wide, free area, access door.

g. Each fan/motor “cube” will be provided with an individual back-draft damper similar to a Ruskin BD6 Heavy Duty 6063T5 extruded aluminum frame, .125” wall thickness. Frame shall have galvanized steel braces on all corners. Blades shall be minimum .070” wall thickness 6063T5 extruded aluminum. Bearings shall be corrosion resistant long life synthetic. Linkage shall be ½” tie bar with stainless steel pivot pins.

h. Each fan assembly shall be supplied with a complete flow measuring system, Huntair Flow-Cone, which indicates airflow in Cubic Feet per Minute. The flow measuring system shall consist of a flow measuring station with four static pressure taps and four total pressure tubes located at the throat of the fan inlet cone. The flow measuring station shall not obstruct the inlet of the fan and shall have no effect on fan performance (flow or static) or sound power levels. A surface mounted indicator (Dwyer Series MS-Magna Sense), located on the unit exterior, shall provide a digital CFM readout, and/or a 4-20 ma output control signal for use in the BAS as specified elsewhere.

i. Provide fan cages around all exposed fans in accordance with the latest OSHA requirements.

j. All fans shall be configured in order that the fan opening can be manually blanked off in order to service, repair, or replace the fan. Provide two blank-off panels for two fans for the air handling unit.

k. Acceptable Manufacturers:

1) Fans shall be as manufactured by air handling unit manufacturer or Huntair, Twin City, Chicago Blower, or New York Blower.

8. Filter Section

a. The unit shall be provided with a filter rack and 4-inch 30% efficient pleated media filters. Filter efficiency is rated per ASHRAE Standard 52-76. Access to the filters shall be through hinged access door. Unit to include additional filter rack, 12 inch MERV 13 pleated media after filter.

b. Unit shall be equipped with energy recovery wheels which include an additional 2" thick pleated media outdoor air filter.

c. Contractor shall provide and install a complete set of new filters (all three types) at building turnover, as well as, provide additional set of attic stock for the AHU.

9. Outside Air/return air/exhaust air (OA/RA/EA) Dampers
   a. Dampers shall be constructed of heavy gauge aluminum airfoil shaped blades. Damper edges have blade seals of extruded vinyl with an inflatable pocket and shall be locked into extruded aluminum blade slots. Dampers shall have flexible side seals of flexible metal compression type. Leakage rate of aluminum dampers shall not exceed 3 cfm/sq. ft. at 3" static pressure differential across the damper.
   b. Furnish and install at outside air, return air, and exhaust air dampers, an air monitoring station integral with outside air control damper, airflow monitoring blades, and air straightening section. The integral air monitoring station shall incorporate measuring ports built into the monitoring blades and shall control the minimum amount of outside air as recommended by ASHRAE Standard 62. Standard construction shall be 4" x 1" .081 (102 x 25 x 2) control damper frame which incorporates mounting flanges both sides. Control damper blades shall be heavy gage extruded aluminum airfoil type with Ruskiprene blade edge seals. Airflow monitoring blades shall be heavy gage anodized extruded aluminum airfoil shaped fixed in 10" (254) 16 GA (1.6) galvanized frame. Jamb seals along control damper sides shall be flexible metal compression type. Damper linkage shall be concealed out of the airstream and located within the damper frame to reduce pressure drop and noise. The integral air monitoring station shall incorporate an air straightener section contained in a 5" (127) long 16 gage galvanized sleeve attached to the monitoring blade frame. The air straightener section shall be flanged as required by the application. Airflow monitoring station shall have tested for pressure drop in accordance with AMCA Standard 610-93 in an AMCA registered laboratory. The airflow monitoring station must bear the AMCA Certified Ratings Seal for Airflow Measurement Station Air Performance. Airflow monitoring station shall be Ruskin Model AMS-50.
   c. Where exhaust connections are not ducted, provide heavy-duty gratings over the exhaust openings. Gratings shall be capable of supporting at least 300 pounds.

10. Electrical Devices
   a. Provide 100 watt equivalent CFL Crouse-Hinds, Appleton or equal vapor proof lighting fixture with lens guard in each section for service. Provide two GFI outlets in the unit. Terminate wiring in junction box mounted on exterior of unit.

11. Piping Locations
   a. The heating coil and cooling coil stubs shall be terminated per the Mechanical Drawings.

12. Energy Recovery Unit Control Panel
   a. A control panel shall be mounted at the Energy Recovery Unit section and have access door(s) for direct access to the controls. The panel shall be equivalent to NEMA type 3R (rainproof) and contain a single externally operated, molded case switch suitable for copper wire up to and including conduit. Door mounted operating mechanism shall have screwdriver interlock pin which allows control panel access without shutting down the unit.
   b. Externally mounted disconnects shall not be acceptable. All wiring shall be run to the main control panel.
      1) The control panel shall include the following:
      2) A main disconnect (single point power supply - 480V)
      3) A power terminal block.
      4) All controls for infrared defrost.
      5) A power transformer with 115 volt secondary and 115 volt control fuse.
      6) A 24 volt control transformer and fuse.
      7) Necessary relays.
      8) A 115 volt terminal strip.

9) A 24 volt control terminal strip containing wired terminals for all controls, numbered in accordance with the wiring diagram.
10) An isolated 24 volt field wiring terminal strip.
11) An electrical print pocket, which in addition to the electrical print, shall contain a startup form.

13. Mounting Curb
    a. All concrete pads and bases shall be installed by the HVAC Contractor. Provide reinforced concrete rail system under the air handling unit as detailed on the HVAC drawings.
14. Schedule of Air Handling Unit: Refer to Schedule of Air Handling Unit on the drawings.

2.2 SOURCE QUALITY CONTROL

A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.

B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

C. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Coordinate the following examination procedures with the HVAC Contractor.

B. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

C. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

D. Examine roughing-in for hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

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

3.2 INSTALLATION

A. Coordinate the following installation procedures with the HVAC Contractor.

B. Arrange installation of unit to provide access space around air-handling unit for service and maintenance.

C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.

D. Install filter-gage, static-pressure taps upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum in accessible position. Provide filter gages on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

3.3 CONCRETE BASES

A. All concrete pads and bases shall be installed by the HVAC contractor.

3.4 CONNECTIONS

A. Coordinate the following connection procedures with the HVAC Contractor.

B. Comply with requirements for piping specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

C. Install piping adjacent to air-handling unit to allow service and maintenance.

D. Connect piping to air-handling unit mounted on vibration isolators with flexible connectors.

E. Connect condensate drain pans using, ASTM B 88, Type L (ASTM B 88L, Type B) copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

F. Chilled-Water Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.

G. Gas Piping: Comply with applicable requirements in Division 23 Section “Gas Piping”.

H. Connect duct to air-handling units with flexible connections. Comply with requirements in Division 23 Section "Air Duct Accessories."

3.5 FIELD QUALITY CONTROL

A. Coordinate the following field quality control procedures with the HVAC Contractor.

B. Manufacturer's Field Service: Provide a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Provide a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Leak Test: After installation, fill water coils with water, and test coils and connections for leaks.

2. Fan Operational Test: After electrical circuitry has been energized, start unit to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.

F. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Provide a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that shipping, blocking, and bracing are removed.
3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
6. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
7. Comb coil fins for parallel orientation.
8. Verify that proper thermal-overload protection is installed for electric coils.
9. Install new, clean filters.
10. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

B. Starting procedures for air-handling unit include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.7 ADJUSTING

A. Assist the successful HVAC Contractor with the following adjusting procedures.

B. Adjust damper linkages for proper damper operation.

C. Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

3.8 CLEANING (BY HVAC CONTRACTOR)

A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling unit internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.9 DEMONSTRATION

A. Provide a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-handling unit. Video training sessions. Provide at least 8 hours of training for Owner’s personnel.

END OF SECTION 23 73 13

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SECTION 23 73 14 – VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections
1. 23 73 13 - Modular Indoor Central Station Air Handling Units

C. Refer to Section 23 73 13 regarding Bidding Information. The Variable-Frequency Motor Controllers shall be furnished by the Air Handling Unit Manufacturer.

1.2 DESCRIPTION OF WORK

A. Furnish the new variable frequency drives of NEMA type 1 construction as hereinafter specified and consisting of the following principal essentials.

B. The start-up of the variable frequency drives shall be performed by the manufacturer, the cost of which shall be included in his proposal. All details of construction and installation shall meet the approval of the Engineer. In addition, manufacturer shall provide the operating instruction manuals and a total of four (4) hours of instruction and training on the operation of the variable frequency drives.

C. The equipment shall comply with the specification, shall be the product of a reputable manufacturer, and shall operate at the manufacturers standard ratings in all respects. All parts shall be suited to the service and not subject to injury under any condition that may occur in the normal operation of the system.

D. The variable frequency drives shall be compatible with any standard NEMA design B, premium efficiency, 1.15 SF, Class H insulation, three phase induction motor.

E. The entire installation shall comply with all state and local laws, and the National Electrical Code.

1.3 SUMMARY

A. Section includes separately enclosed, pre-assembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.4 DEFINITIONS

A. AHU: Air Handling Unit

B. BAS: Building automation system.

C. CPT: Control power transformer.

D. EMI: Electromagnetic interference.

E. IGBT: Insulated-gate bipolar transistor.

F. LAN: Local area network.

G. LED: Light-emitting diode.

H. MCP: Motor-circuit protector.

I. NC: Normally closed.

J. NO: Normally open.

K. OCPD: Overcurrent protective device.

L. PCC: Point of common coupling.

M. PID: Control action, proportional plus integral plus derivative.

N. PWM: Pulse-width modulated.

O. RFI: Radio-frequency interference.

P. TDD: Total demand (harmonic current) distortion.

Q. THD(V): Total harmonic voltage demand.

R. VFC: Variable-frequency motor controller (drive).

1.5 SUBMITTALS

A. Product Data: For each type and rating of VFC indicated. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, and furnished specialties and accessories.

B. Shop Drawings: For each VFC indicated. Include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.
   1. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Each installed unit's type and details.
      b. Factory-installed devices.
      c. Enclosure types and details.
      d. Nameplate legends.
      e. Short-circuit current (withstand) rating of enclosed unit.
      f. Features, characteristics, ratings, and factory settings of each VFC and installed devices.
   2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring.

C. Product Certificates: For each VFC, from manufacturer.

D. Source quality-control reports.

E. Field quality-control reports.

F. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals. Include the following:
   1. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and MCP trip settings.
   2. Manufacturer's written instructions for setting field-adjustable overload relays.
   3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
   4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

G. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.

H. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

D. IEEE Compliance: Fabricate and test VFC according to IEEE 344 to withstand seismic forces.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store VFC’s indoors to clean, dry space with uniform temperature to prevent condensation. Protect VFC’s from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions unless otherwise indicated:
   1. Ambient Temperature: Not less than 14 deg F and not exceeding 104 deg F.
   2. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.
   3. Humidity: Less than 95 percent (noncondensing).

4. Altitude: Not exceeding 3300 feet.

1.9 COORDINATION

A. Coordinate features of motors, load characteristics, installed units, and accessory devices to be compatible with the following:
   1. Torque, speed, and horsepower requirements of the load.
   2. Ratings and characteristics of supply circuit and required control sequence.
   3. Ambient and environmental conditions of installation location.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

1.11 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. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
   2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
   3. Indicating Lights: two of each type and color installed.
   4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
   5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. ABB – Series ACH 550.
   2. Yaskawa Electric America, Inc.; Drives Division.

B. General Requirements for VFCs: Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.

2.2 VARIABLE FREQUENCY MOTOR CONTROLLERS (DRIVES)

A. For air handling unit fans, provide one drive for every two fans. Drives shall not be equipped with a bypass switch.

B. Each variable speed drive package for air handling unit supply fans and air handling unit return fans, shall consist of a non-fusible disconnect switch, a non-fusible disconnect service switch, control power supply, fuses, relays and terminals, all installed in a single standardized NEMA type 1 enclosure.

C. A disconnect shall be provided in the incoming line of each VFC package and shall consist of a 600 volt A.C. 3 pole non-fusible disconnect switch with quick-make, quick-break mechanism. The operating handle of each disconnect shall clearly indicate whether the switch is "ON or "OFF". External operating handle shall be equipped with provision for locking disconnect in "OFF" position.

D. Variable Frequency Drive
1. The variable frequency drive controller shall be microprocessor based, fully transistorized pulse width modulated (PWM) design producing a sine-coded output waveform. The output transistors shall be of insulated gate bipolar transistors (IGBT) with soft switching technology to facilitate noiseless motor operation and improved reliability.
2. The variable frequency drive controller shall be equipped with a graphic back-lit liquid crystal display (LCD) and keypad which can be configured to display, output frequency, current, set points, VFC status and fault codes, BACNET card, etc.
3. Operating features:
    a. Linear speed control from 0% to 100% of maximum speed.
    b. The variable frequency drive shall be able to withstand input voltage variations of 15% below and 10% above 460 volt 3 phase nominal, and imbalance no greater than 3% without tripping or adversely affecting drive performance.
    c. The displacement power factor of the variable frequency drive shall be 95% lagging or higher for all speeds.
    d. Drive efficiency at rated load shall be 95% or higher.
    e. "Speed search" transfer: Drive shall have the ability to automatically start into a spinning motor without stopping the motor or creating a fault condition.
    f. Auto restart: programmable "intelligent" auto restart precludes any attempt at restart in the event of trips typically indicative of component failure. Programmable for up to ten (10) restarts.
    g. Minimum of two second power loss ride-through capability. In the event of a loss of power lasting two seconds or less the drive shall maintain operation and prevent nuisance trips upon return of power. In the event of a loss of power lasting more than two seconds, the auto restart function shall restart drive.
    h. Output three phase current sensing class 20 overload relay to provide motor protection.
    i. Carrier frequency: 1 to 12KHZ
    j. Acceleration and deceleration settings: 0.1 to 1800 seconds, using three modes (linear, S-curve, non-linear).
    k. System Control interfaces: The variable frequency drive shall be set up to accept control signals from the campus DDC system through the drives standard embedded fieldbus (EFB) using standard BAC net protocol.
    l. 24 volt DC level commands for remote digital inputs to drive to indicate:
        1) Start/Stop
        2) Control (Preset) Speed 1
        3) Safety Interlock

m. 230 volt AC rated contacts for remote indication of VFD status.
   1) VFD ready
   2) VFD run
   3) VFD fault

n. Remote serial control: Each VFD shall be equipped with standard BAC net communication interface protocol for connection to the campus DDC system to integrate VFD specific parameters into the system such as operating characteristics (current, voltage, frequency) and inverter faults. A separate RS-232 port shall be provided for connection to an external PC for troubleshooting purposes without interrupting the operation of the RS-485 link.

E. All variable frequency drives for use with AHU supply and return fans shall be equipped with a keypad/annunciator panel to show all HVAC specific data for intuitive, convenient operation by building personnel. Annunicator shall include the following:
   1. A single-line diagram of power circuit with LED indicators for status of each of the following components:
      a. Ready
      b. Enable
      c. VFD run
   2. LED indicators for status of the following alarm conditions:
      a. VFD fault
   3. Individual keypad pushbuttons and LED indicators for the following:
      a. VFD reset
      b. VFD auto
      c. VFD off
      d. VFD hand

F. Nameplates
   1. On the front of each variable frequency drive, provide suitable black plastic nameplate with white cut letters. Abbreviations will not be permitted unless authorized by the Engineer.

G. Schedule Of Variable Frequency Drives
   1. Refer to Drawings

2.3 SOURCE QUALITY CONTROL

A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.
   1. Test each VFC while connected to a motor that is comparable to that for which the VFC is rated.
   2. Verification of Performance: Rate VFCs according to operation of functions and features specified.

B. VFCs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Coordinate the following examination procedures with the HVAC Contractor.

B. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.

C. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

D. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

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

3.2 INSTALLATION

A. Coordinate the following installation procedures with the HVAC Contractor.

B. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

C. Wall-Mounting Controllers: Install VFCs on walls with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished floor unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall.

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in each fusible-switch VFC.

F. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."

G. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

H. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

I. Comply with NECA 1.

3.3 IDENTIFICATION

A. Assist the HVAC Contractor with the following identification procedures.

B. Identify VFCs, components, and control wiring.
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each VFC with engraved nameplate.
   3. Label each enclosure-mounted control and pilot device.

C. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.4 CONTROL WIRING INSTALLATION

A. Assist the HVAC Contractor with the following control wiring installation procedures.

B. Install wiring between VFCs and remote devices and facility's central-control system.

C. Bundle, train, and support wiring in enclosures.

D. Connect selector switches and other automatic control devices where applicable.
   1. Connect selector switches to bypass only those manual- and automatic control devices that have no safety functions when switches are in manual-control position.
   2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

A. Assist the HVAC Contractor with the following field quality control procedures.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Provide a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.
   1. Manufacturer's Field Service: Provide factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

E. Acceptance Testing Preparation:
   1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

F. Tests and Inspections:
   1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
   2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
   3. Test continuity of each circuit.

4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Engineer and Commissioning Agent before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

G. VFCs will be considered defective if they do not pass tests and inspections.

H. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP SERVICE

A. Provide a factory-authorized service representative to perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Assist the HVAC Contractor with the following adjustment procedures.

B. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

C. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

D. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Engineer and Commissioning Agent before increasing settings.

E. Set the taps on reduced-voltage autotransformer controllers.

F. Set field-adjustable pressure switches.

3.8 PROTECTION

A. Assist the HVAC Contractor with the following protection procedures.

B. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

C. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.9 DEMONSTRATION

A. Provide a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs. Video training sessions. Provide a minimum of 4 hours of training for Owner’s personnel.

END OF SECTION 23 73 14

SECTION 25 00 00 – INTEGRATED AUTOMATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes a summary of all Integrated Automation which is principally Direct Digital Control (DDC System) related work.

B. Related Sections:

1. 25 04 00 – GENERAL DIRECT DIGITAL CONTROLS REQUIREMENTS (DDC)
2. 25 05 10 – DIRECT DIGITAL CONTROL SYSTEM (DDC)

C. Work by Others:

1. The following work will be done by other contractors, as specified under respective headings, which this contractor shall read to ascertain what is called for therein:

    a. General Construction
    b. Fire Protection
    c. Plumbing
    d. HVAC
    e. Electric
    f. Technology

1.3 GENERAL

A. This contract shall include the furnishing of all labor and materials required for the installation of new temperature regulating systems to monitor, control, and regulate automatically and completely the new chiller, as shown on the accompanying drawings and hereinafter specified. The temperature control equipment shall be installed by trained mechanics and technicians employed by the manufacturer and working in conjunction with the other contractors.

B. Bids for the temperature control work, hereinafter specified, shall be based upon a Siemens direct digital control system with electronic sensors for indication and control functions, electrically actuated devices including new valves, etc., and all connections to sensors and actuated devices. All bidders of controls shall comply with this specification and shall provide any additional labor, hardware, software, programming, network integrators, etc., to communicate with, control and display graphically the new systems.

C. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this project.

D. The BMS as provided shall incorporate, at minimum, the following integrated features, functions and services:
1. Operator information, alarm management and control functions.
2. Enterprise-level information and control access.
3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
4. Diagnostic monitoring and reporting of BMS functions.
5. Offsite monitoring and management access.
6. Energy management.
7. Standard applications for terminal HVAC systems.

E. Acceptable Manufacturers and Installers:
1. Siemens Controls.

F. The BMS Contractor shall be a recognized national manufacturer, installer and service provider of BMS. The BMS Contractor shall have a branch facility within a 50-mile radius of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis.

G. The Building Management System architecture shall consist of the products of a manufacturer regularly engaged in the production of Building Management Systems, and shall be the manufacturer's latest standard of design at the time of bid.

H. The new systems shall be complete with all piping connections, switches, relays, wiring, or other devices required to accomplish the required results. All control devices shall be of the manufacturer's best construction. Complete shop drawings of the control system shall be submitted for approval. Contractor shall become thoroughly familiar with interconnections, with equipment specified under other sections of this specification including electric work, and all work furnished by the Direct Digital Control Contractor shall be coordinated therewith.

1.4 PROJECT CONDITIONS

A. Alterations of and Additions to Existing DDC Systems

1. The contract shall include new work as shown, specified, or required, and shall include, but not limited to, the following principal components:

a. Provide complete system for control of all equipment and systems as specified herein.
b. Provide interface with certain components such as air handling system.
c. Furnish and install all requisite wells and devices for temperature, pressure, alarm, indication, etc.
d. Furnish and install UPS equipment for new control system. All components of control system shall be on UPS power. Contractor shall provide the requisite equipment to back-up all control functions for 30 minutes.
e. Perform start-up for all DDC systems and commission same in accordance with the commissioning requirement.

f. Provide and/or participate in training of Owner's personnel on the use of all new DDC systems.

2. The contractor shall exercise adequate protective and safety measures for all persons and property and shall be responsible for any damages or injuries arising from the execution of this work.
3. Alterations and additions to existing work shall include the requisite rigging, wrecking, hauling, protections of permanent equipment and the building structures, and cleaning up. Care shall be exercised to keep dust and dirt to a minimum and to confine it to the area where the removal work is being performed. All debris shall be promptly removed.
4. The existing facility will be occupied and will remain in operation throughout the period that this work is being performed, and certain new work will be performed during this period. Unscheduled interruptions of the facility will not be tolerated. The contractor shall exercise extreme caution, shall thoroughly inform his workmen and subcontractors of the critical nature of this work, and shall continually review the work procedure being followed in order to prevent accidental interruption of service. Before performing any act which could result in interruption of service, the contractor shall notify the Owner and Engineer of the hazards involved and the contractor shall proceed in a manner and at a time specifically approved by the Owner and Engineer.
5. All work necessitating the temporary turning off or shutting down the operation of existing mechanical and/or electrical facilities shall be done at times specifically approved by the Owner and Engineer in advance of any disruption of existing facilities. Also, refer to Section 25 04 00 – General Electrical Requirements.

B. Shop Drawings

1. As soon as possible after award of the contract, and prior to fabrication, the contractor shall prepare complete shop drawings of the DDC systems, which shall in general conform to the bidding documents; any deviations deemed necessary by the contractor shall be noted and agreed upon prior to starting the work.
2. In preparing his working drawings, the contractor shall coordinate the location of all equipment and devices with the other contractors. Drawings shall show ceiling grids, lights, registers, grilles, heat detection devices, access panel, skylights, A/V devices and equipment, etc. Any changes in fabricated DDC layout occasioned by lack of coordination shall be made by the contractor at no change in the contract price.
3. Drawing shall be on 11" x 17" or 18" x 24" sheets at the contractor's option.
4. All submittals shall be in PDF format and routed through the General Contractor.
5. The submittals shall include control diagrams of all equipment that is to be controlled, monitored, etc. The submittal shall include all of the control information for air handling systems, variable frequency drives, etc.
6. The contractor shall implement all control sequences specified and indicated on the input/output schedules.
7. Each input/output device shall have a unique identifier which shall be permanently labeled on or adjacent to the device. The unique identifier shall be labeled on the various submittals as well.

C. Excavation And Backfilling And Restoration Of Surfaces

1. Refer to Section 25 04 00 and Division 01.

D. Guarantee

1. This contractor shall guarantee all workmanship, materials, and equipment entering into this contract for a period of two years; all from date of substantial completion or from the "recognized" start-up date, whichever is later. Should the Owner elect to accept a portion of work prior to the date of substantial completion, the guarantee period for the accepted

portion of the work shall commence on the date of acceptance or on the "recognized" start-up date for that portion of the work, whichever is later. If the specifications dictate a different period of guarantee for a given component or piece of equipment, the more stringent requirements shall govern.

2. The "recognized" start-up date shall be defined as that date on which the contractor has successfully completed all work, including the following:

    a. Submitted and received approval of four (4) copies of the Instruction Booklets.
    b. Submitted complete "As-Built" drawings.
    c. Completed all testing, cleaning, adjusting, and trial run. This testing shall include the successful completion of all commissioning tasks.

3. In the case where the Engineer is accepting a portion of the work, the contractor shall have completed all work to be accepted, including Items above, for that accepted portion of the work.
4. Any workmanship, materials, or equipment proving to be defective during this guarantee period shall be made good by this contractor without additional cost to the Owner.
5. Refer to Division 00.

E. Equipment

1. Any and all costs associated with piping, electric, wiring, conduit, supports, pads, or other modifications to accommodate installation for manufacturer's equipment that differs from equipment layout on drawings shall be included on contractor's bid. The contractor is responsible to insure that the equipment will fit within space allocated with appropriate clearances for maintenance, operation, servicing, and code.

F. Schedule

1. The contractor shall be responsible to meet the project schedule as stated by the Owner. The contractor shall include in his bid the cost associated with all requisite coordination.
2. In addition, the contractor must prepare a schedule for his work that integrates with the Owner's schedule. The contractor shall update progress and revise schedule at least twice monthly.
3. This contractor shall be responsible to expedite any materials and work any overtime in order to meet the schedule. The cost for any expediting of overtime work shall be included in his bid.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 25 00 00

SECTION 25 04 00 - GENERAL DIRECT DIGITAL CONTROLS REQUIREMENTS (DDC)

PART 1 - GENERAL

1.1 HVAC BRANCHES

A. The following paragraphs are applicable to Division 25 and are complementary to other sections of specifications. Where items described in other sections of the specifications are repeated herein, it is done to call special attention to or to qualify them, but it is not intended that any part of the documents shall be assumed to be omitted if not repeated herein.

B. Where contradictions occur between this section and Division 1, the most stringent of the two shall apply. Architect/Engineer shall decide which is most stringent.

1.2 DRAWINGS AND SPECIFICATIONS

A. HVAC drawings are diagrammatic and indicate general arrangement of systems and work included in the contract and shall be adhered to insofar as possible. The drawings and specifications are complementary and are intended, without giving every minute detail, to cover a workable installation complete in every respect including, whether mentioned or not, all material and equipment usually furnished with such systems and/or needed to make a complete operational installation omitting only such parts as are specifically excepted.

B. Consult drawings and details for exact location of fixtures and equipment, and where not definitely indicated, request this information in writing.

C. The specification for each division of the work is written in sectional form for brevity and convenience in reference, without repeating in each section all applicable general clauses and/or pertinent data covered elsewhere in the specification, but it is not intended that any of the documents shall be assumed to be omitted if not repeated in each division.

D. Where specifications are written for brevity, with incomplete sentences, the omission of words or phrases, such as "the contractor shall", "shall be", "provide", "furnish", "all", etc. are intentional and such omitted words or phrases shall be supplied by inference; unless otherwise mentioned, such clauses, lists, and/or directives indicate work to be done by the contractor for that specific division of work.

1.3 LAWS AND ORDINANCES

A. Contractors who perform any work under this contract shall fully comply with the provisions of the Federal Occupational Safety and Health Act of 1970 (as amended) and with any rules, regulations, and revisions pursuant to that Act. It is intended that the work shall conform in every regard to all local, state, and federal laws, and to the ordinances and rules and regulations of the locality and the Department of Water, Sewers, Fire, Health, Buildings, and Police Department, whether specifically mentioned herein or not. Each contractor shall submit all requisite documents and notices, obtain and pay for any permits, inspections, approvals, etc. required for his work by such agencies or departments having legal jurisdiction over the work. Should anything in the plans or specifications be at variance with such rules and regulations, the contractor shall notify the Engineer, in writing, to that effect and shall not proceed until the matter in question is resolved.

1.4 PERMITS AND REGULATIONS

A. "Permits, Fees, and Notices" of the General Conditions of the contract shall govern. The Owner will acquire the Building Permit for this project and pay all charges associated therewith. Mechanical Contractors requiring other plan reviews, permits, and inspections shall secure and pay for same and shall include cost of same in their proposals.

B. Certificates showing the inspections have been made and approval has been received shall be submitted to the Engineer at the completion of the job prior to submission of request for final payment.

1.5 CODES AND STANDARDS

A. Unless otherwise specified, all materials and workmanship shall comply with the latest editions of the following codes and standards:

1. All Work: All Local, State Building Laws and Codes, and Americans with Disabilities Act.

2. Boilers: ASME and State Boiler Codes.

3. Combustion Equipment: NFPA and U.L. Labeled.

4. Cement, Metals, Pipe, Etc.: ASTM Standard Specifications. Tanks: State, including State Fire Marshall, EPA, and ASME Code for Unfired Pressure Vessels.

5. Piping: State and ANSI Codes for Pressure Piping.

6. Electrical Work: NFPA National Electric Code, NBS National Electrical Safety Code, and NFPA Standards.

7. Electrical Materials: U.L. List of Inspected Materials and NEMA Standards.

8. Connections to Public Utilities: Regulations of Local Departments of Water and Sewers, the local Gas and Electric Company, and the local Telephone provider.

9. Refrigeration Equipment: ANSI Code and State Code for specific requirements covering installation, maintenance, and operation of pressure piping and mechanical refrigeration systems and all applicable regulations implementing the Stratospheric Ozone Protection Provisions of the 1990 Amendments to the Clean Air Act.

10. Heating, Air Conditioning, and Ventilation Equipment: ASHRAE Code and Standards.

11. Fire Dampers, Safety Devices, Burners and Piping, Tanks, Etc.: NFPA Standards and Regulations.

12. OSHA Regulations: All work shall be performed in accordance with OSHA Regulations. The contractor shall have a competent person on site during the course of the project to ensure compliance with these federal workplace standards.

B. The above codes and standards are minimum requirements; however, when plans and/or specifications call for higher standards, the plans and/or specifications shall govern.

1.6 VERIFYING CONDITIONS

A. The work under this contract occurs on the site of and within the existing facility. The work under this contract shall be scheduled and performed so as to provide a minimum of interference with the normal operation of the existing facilities.

B. Before submitting a proposal, contractors shall visit the site, and shall also carefully examine all bidding documents including those for other branches of the work, to satisfy themselves as to the nature and scope of all work to be done. Prints showing the original building architectural, structural, mechanical, and electrical work are available at the Engineer's office for contractors' review.

C. The submission of a proposal shall be taken as evidence that such an examination has been made and difficulties, if any, noted. Later claims for labor, work, material, and equipment required for any difficulties encountered which could have been foreseen, shall not be recognized, and all such difficulties shall be properly taken care of by the contractor at no additional expense to the Owner.

1.7 EXISTING WORK AND/OR CONDITIONS

A. The accompanying drawings and specifications illustrate and describe the existing conditions, mechanical utilities, sewers, water mains, pipes, ducts, conduits, etc. that are particularly relevant to the new work insofar as these mains are shown on existing records or evident by field inspections and tests; however, it is not the intent that these documents shall be construed to guarantee to the contractor the exact location of these items. Each contractor shall verify and determine the exact location of these items in the field, and all work under this contract shall be executed to avoid conflict with or damage to existing work. The work shall be planned and executed to avoid interference, as much as possible, with traffic and with the normal use of the existing facility.

B. All work involving hazards to persons shall be suitably barricaded and provided with warning lights or signs, as required.

C. Where necessary for the performance of the contract, existing work shall be cut, altered, removed, or temporarily removed and replaced. Work that is altered or replaced shall match similar existing work and said work shall be performed by trade applicable to the work; if said work is NOT shown or noted the Drawings relating to applicable trade, cost shall be paid by contractor requiring said work. However, unless otherwise provided by the drawings or specifications, no structural members shall be cut or altered without authorization of the Architect and Engineer. Work remaining in place, which is damaged or defaced by reason of work done under this contract, shall be restored in kind equal to its condition at the time of award of the contract by applicable trade as hereinbefore specified.

D. Existing work shall not be disturbed further than necessary for proper installation of new work. New work to be connected or made integral with existing work shall be properly erected to secure solidity and be continuous in finish. Such new work in extension of existing work shall correspond in all respects with that to which it connects, or similar existing sound work, unless otherwise specified.

1.8 EXISTING MECHANICAL FACILITIES

A. Where existing mechanical facilities and/or service lines occur in the area of the work and such facilities or lines are to be abandoned or changed, the contractor for the branch of work or trade involved shall cut off and properly cap the old lines, so as not to interfere with the new construction work. If any portions of such lines are required for the operation of an existing building the lines shall be altered and relocated to clear new construction and shall also be restored into service to provide continued operation of the existing building.

1.9 INTERRUPTION OF SERVICES

A. Work which requires the temporary turning off or shutting down the operation of existing mechanical and/or electrical facilities shall be done at times specifically approved by the Owner or utility company and the work shall be pre-scheduled and executed so there is a minimum outage of such services and/or delay in the new construction work.

B. Unscheduled interruptions of the facility will not be tolerated. The contractor shall exercise extreme caution, shall thoroughly inform his workmen and subcontractors of the critical nature of this work, and shall continually review the work procedure being followed in order to prevent accidental interruption of service. Before performing any act which could result in interruption of service, the contractor shall notify the Owner and Engineer of the hazards involved and the contractor shall proceed in a manner and at a time specifically approved by the Owner and Engineer.

C. All work necessitating the temporary turning off or shutting down the operation of existing mechanical and/or electrical facilities shall be done at times specifically approved by the Owner and Engineer in advance of any disruption of existing facilities.

1.10 MATERIALS AND EQUIPMENT

A. All materials and equipment entering into the work shall be approved by the Engineer, and must be new, without defects, and of the sizes and capacities shown on the drawings or hereinafter specified. All manufactured materials or equipment shall bear the identification mark of the manufacturer or, if required by the Engineer, shall be certified by an approved testing laboratory. All equipment shall operate within the manufacturer's range of speeds, guaranteed capacities, performance, etc. as indicated by the manufacturer's latest catalog and/or engineering data, shall be of proper size and dimension for the allocated space, and shall be placed in the space allocated in the proper construction sequence. Special consideration will be given to equipment which has been in successful field use or similar applications for at least three (3) years (exclusive of field tests), and to equipment which has an extended guarantee period in lieu of long use period. The contractor shall submit with his bid complete data on equipment he proposes to use; failure to so submit, or to meet these requirements fully and those of the specifications, shall be grounds for rejecting the items.

B. All electrical materials, apparatus, and equipment shall be new, of the make and characteristics specified, shall conform to NEMA standards, and shall be designed to comply with and be installed in accordance with the latest rules and regulations of the National Electrical Code, and all of the legally constituted public authorities having local jurisdiction. Verify the exact voltage and current characteristics at the building before ordering motors or similar equipment.

C. All motors shall be NEMA frame sizes, heavy duty, 40 degree C. ambient motors with ball or roller bearings and with maximum full load temperature rise not exceeding NEMA limits of temperature rise. All motors shall have adequate starting and protective equipment as

specified or required, and shall have a conduit terminal box of size adequate to accommodate conduits and wires as sized on electrical drawings or as specified. The capacity of each motor shall be sufficient to operate associated driven devices under all conditions of operation and load without overloading or overheating and each motor shall be of not less than the horsepower indicated or specified.

D. Conduct such tests and adjustment of equipment as specified or necessary to verify performance requirements. Submit data taken during such tests.

1.11 QUIET OPERATION

A. The work shall be installed in such a manner that under all conditions of load it shall operate without sound or vibration which is objectionable in the occupied spaces, in the opinion of the Engineer.

B. In case of moving machinery, sound or vibration noticeable outside of the room in which it is installed or annoyingly noticeable inside its own room will be considered objectionable. Sound or vibration considered objectionable shall be corrected by the contractor.

1.12 PROTECTION

A. In performing this contract, safeguard workmen and the public and protect the work and equipment until final completion and acceptance. After delivery and before and after installation, protect work against theft, injury, or damage. Carefully store material and equipment received on site which are not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing materials. Protect related or adjacent work and the material of the other trades or the Owner from damage that might be caused by this work and make good any damage thus caused. Provide all safeguards, scaffolding, drop cloths, etc. as required.

B. No welding or soldering shall be done near combustible materials of any kind; all adjoining work, finished surfaces, glass, etc. shall be protected from flames, sparks, hot metal, etc. by metal guards or approved noncombustible drop cloths or barriers.

C. Each contractor shall replace any items or portions thereof wherever removed or damaged, in a manner equal to the original construction and finish, or where directed by the Engineer, he shall pay other trades to perform this work.

D. All mechanical equipment with a factory finish shall be protected during construction and must be free of dust, dirt, cement splatters, etc. when the building is turned over to the Owner. Dents and marred finishes shall be repaired to the satisfaction of the Engineer, or a replacement furnished where necessary.

E. Provide belt drives and rotating machinery with readily removable guards complying with OSHA requirements to enclose the drive completely and consisting of heavy angle iron frames, hinged and latched, with heavy galvanized iron wire crimped mesh or sheet steel securely fastened to frames.

1.13 EXECUTION OF WORK

A. The integrated automation work shall be performed and coordinated with the program of the General Contractor and the other subcontractors. Promptly upon award of the contracts, the subcontractors shall confer with the General Contractor and the Engineer and other subcontractors to prepare a time schedule for the completion of the various

divisions and details of the work. Each subcontractor shall proceed diligently with the work and shall cooperate with the General Contractor and the other contractors to maintain the approved time schedule to the best of his ability and as conditions permit.

1.14 GENERAL SUPERVISION AND INSTALLATION OF WORK

A. Each contractor shall at all times give the work his best skill and attention, including adequate construction supervision over his work, employees, and subcontractors, and he shall fully cooperate with and confer with the Engineer and other contractors so that the best possible installation shall be obtained. Exact locations and relations are to be determined in the field, subject to the approval of the Engineer, and with preference to the dimensioned and architectural and structural drawings and approved shop and setting drawings.

B. Unless otherwise shown, pipes, ducts, etc. in rooms with finished ceilings, shall be concealed in furred ceilings, shafts, walls, and floors, and all work must be exactly and accurately located to conform with the spaces provided therefor. In general, all other new piping, ducts, etc. in mechanical equipment rooms, telephone rooms, etc. shall be exposed.

C. Install pipes, ducts, etc. in a neat and workmanlike manner, close to walls, generally as high as possible, true and square to the building, utilizing standard practices, and properly graded for correct functioning of the system involved; multiple lines in close proximity shall be coordinated and neatly grouped. Install work in proper construction sequence and arranged so as to be readily accessible for operation, maintenance, and repair; minor deviations from drawings may be made to accomplish this, but changes of magnitude or which involve extra cost shall not be made without approval. All fixtures, outlets, etc. shall truly center with the adjacent architectural finish. All work, both exposed and concealed, shall meet the approval of the Engineer regarding neatness of appearance, location, and practicability of installation. The Engineer reserves the right to direct the removal and replacement of any item which, in his opinion, does not present an orderly and reasonably neat and workmanlike appearance.

D. Each contractor shall familiarize himself with the work of the other contractors, shall perform and coordinate his work with the other contractors, shall lay out his work to meet conditions at the building, shall give freedom to and prevent conflict with the work of other contractors, and shall make reasonable modification in locations or arrangement from those indicated on the drawings if required to avoid conflicts or to conform to tile, wood, marble, or other architectural finish. From time to time as the work progresses, the contractor shall examine the work installed by others, insofar as it may affect his work, and he shall, before proceeding with the work, notify the Engineer in writing, if any condition exists which prevents the successful installation of his own work.

E. If the contractor places any work in violation of any of the above mentioned requirements, and conflicting or unworkmanlike conditions result, he shall, without additional charge, remove and reinstall or satisfactorily readjust such portions of his work as may be necessary and as the Engineer may direct. The Engineer's decision regarding such conditions shall be final.

1.15 PRICE BREAKDOWN

A. At the Engineer's request, the contractor shall furnish on a form approved by the Engineer a breakdown of cost of labor and material on each of the several items, the total of which shall equal the contract amount. This data shall be received in the office of the Engineer prior to the approval of the first estimate of payment of the contract, and shall be used for the purpose of proving monthly cost estimates.

1.16 ENGINEER'S OBSERVATION

A. A periodic inspection of the work by the Engineer, commonly referred to as supervision, is only for the express purpose of verifying compliance by the contractor with the contract documents. Such engineering inspections and services rendered by the Engineer or his representatives shall not be construed as the supervising of construction; nor the assuming by the Engineer of the duties and responsibility of the contractors nor making the Engineer responsible for providing a safe place or procedure for the performance of the work or for the contractor's employees or for subcontractors.

1.17 EXCAVATION AND BACKFILLING OF TRENCHES, ETC.

A. This paragraph does not apply to this project.

1.18 RESTORATION OF SURFACES AND CONCRETE WORK

A. Unless otherwise specified, all new concrete work for parking lots, driveways, pads, etc. shall be provided by the General Contractor. All surfaces such as concrete floors, walls, or other surfaces disturbed in the execution of this work by this contractor, and which remain in use, shall be restored in kind by this contractor, or he shall pay the cost of such work.

B. Concrete Work, shall be performed by a qualified, competent, Concrete Contractor, approved by the Owner and work shall comply with the following:

1. All concrete for restoration shall be 4000 PSI compressive strength concrete with reinforcing steel.

1.19 SLEEVES, CUTTING, PATCHING, CLEANING, WATERPROOFING, ETC.

A. Provide and accurately set frames and Schedule 40 steel pipe sleeves for required openings in new work to minimize cutting. Perform all cutting, patching, etc. required to install the work. Use approved power operated boring machine for small holes wherever practical. Remove all rubbish incidental to the work. Where any work pierces waterproofing, provide all necessary sleeves, caulking, and flashing required to make openings absolutely watertight.

B. Refer to the ACI Code 381.71, Section 6.3 for limitations and requirements for penetrations and openings.

1.20 PATENTS

A. The contractor shall defend and guarantee the Owner against any expense, claims, litigation, etc. occasioned by the use in this work of any materials, devices, etc. covered by patents not owned by the contractor, or of which he is not a licensed user.

1.21 SHOP DRAWINGS

A. The contractor and subcontractor shall thoroughly check and verify all field measurements and shall submit to the Engineer, with such promptness as to cause no delay in his own work or that of any other contractor, copies of all shop or setting drawings and schedules required for the work of the various trades.

B. Subcontractors shall submit their shop drawings to the Engineer through the contractor under whom their work is to be performed.

C. The quantity of each shop drawing submitted initially, and when resubmitted, shall comply with the General Conditions. The contractor shall also furnish additional copies as may be needed.

D. The contractor shall thoroughly check shop drawings to ascertain their compliance with the Engineer's drawings and specifications, plainly marking all corrections on all copies of each drawing before submitting them to the Engineer for his general inspection and final review. All shop drawings shall bear the stamp of approval of the contractor. All drawings submitted without this stamp will not be reviewed by the Engineer but will be returned to the contractor for checking, stamping, and resubmission.

E. With respect to all shop drawings, the Contractor shall certify that their organization has thoroughly reviewed and approved each submittal; verified the products required; coordinate electrical characteristics with electric documents; coordinated and verified all associated field dimensions, adjacent construction work, and required clearances including verification that given product will fit in desired location; and determined that the work and the materials described in a given shop drawing submittal are in accordance with the requirements of the work and the contract documents. Any costs to remedy deficiencies resulting from failure to comply with the above requirements shall be borne solely by the contractor.

F. The contractor shall make every effort to submit shop drawings that comply with the drawings, specifications, and design intent. The Engineer will review up to two submittals for a given piece of equipment, material, etc. without cost to the contractor. If at the conclusion of the second review the Engineer cannot in good conscience allow the given item to be fabricated without further shop drawing review, the Contractor shall reimburse the Engineer for all time and expenses (postage, delivery, copying, etc.) for additional shop drawing review time. For the third submittal and after, the Contractor shall issue a Purchase Order to the Engineer with each subsequent submittal based upon a time and material review not to exceed $150/hour.

G. Where dimensions shown on shop drawings are field measurements, they shall be plainly noted as such. Where field measurements differ from the dimensions shown on the contract drawings, they shall be plainly noted.

H. The Engineer will check with reasonable promptness all shop drawings and schedules only for the conformance to the design concept of the project and compliance with the information given in the contract documents.

I. The Engineer's review of such drawings or schedules shall not relieve the contractor from responsibility for deviations from drawings or specifications. The contractor shall remain responsible for dimensions, quantities, and coordination with other trades unless he has, in writing, called the Engineer's attention to such deviations at the time of submission and secured his written approval. The Engineer's review shall not relieve the contractor from responsibility for errors in the shop drawings or schedules.

J. If data returned by the Engineer is marked REJECTED or REVISE AND RESUBMIT, all corrections shall be made as noted thereon, and drawings shall be resubmitted.

K. No equipment shall be manufactured and no fabrication shall be started on any work until shop drawings have been reviewed and stamped REVIEWED or FURNISH AS CORRECTED. If equipment manufacture or fabrication is begun using drawings stamped FURNISH AS CORRECTED, all corrections noted thereon shall be incorporated in manufacture or fabrication work.

L. Errors in shop drawings, or undue delays of the manufacturer in making corrections, are not acceptable excuses for changing delivery date or for imperfect fabrication.

M. At completion of the job, furnish three (3) additional copies of all shop drawings for Owner's manual as hereinafter specified.

1.22 INSTRUCTION BOOKLETS

A. The contractor shall obtain from manufacturers of equipment operating and maintenance booklets, spare parts lists, and approved shop drawings relevant to the proper care and operation of the equipment. The contractor shall prepare an operating manual, describing the operation of the system and equipment and a recommended maintenance schedule, including such information as location, function, maintenance requirements, name and address of supplier, and source of replacement parts for motors, fans, pumps, refrigerating machines, starters, and similar equipment. This data shall be assembled in 8-1/2" x 11" loose-leaf binders, shall be complete, clean and legible, and shall be submitted to the Engineer for approval and editing. Four final approved copies shall be furnished (three copies shall become the property of the Owner; one copy shall be retained by the Engineer).

1.23 AS-BUILT DRAWINGS

A. The contractor shall maintain a record set of drawings which he shall mark up with each deviation clearly indicated in red pencil. It shall be clearly identified as to the exact routing of piping, conduit, ductwork, and accessories. These drawings shall be turned over to the Engineer upon completion by the contractor and will become the property of the Owner. Data must be kept up to date as work progresses.

1.24 GUARANTEE

A. The installing contractor shall guarantee the fan speed control devices for two years, the steam pressure reducing valves for two years, the condensate pumps for two years, and the automatic flow control valves for five (5) years.

B. Each contractor shall guarantee all other workmanship, materials, and equipment entering into their contract for a period of one year; all from date of substantial completion or from the "recognized" start-up date, whichever is later. Should the Owner elect to accept a portion of work prior to commissioning testing and acceptance by commissioning team, the guarantee period for the accepted portion of the work shall commence on the date of acceptance or on the "recognized" start-up date for that portion of the work, whichever is later.

C. The "recognized" start-up date shall be defined as that date on which the contractor has successfully completed all work, including the following:

1. Submitted and received approval of three (3) copies of Instruction Booklets (refer to Paragraph 1.22 above).

2. Submitted complete "As-Built" drawings (refer to Paragraph 1.23 above).

3. Completed all testing, cleaning, adjusting, and trial runs.

D. In the case where the Owner is accepting a portion of the work, the contractor shall have completed all work to be accepted, including items 1.24.C.1, 1.24.C.2, and 1.24.C.3 above, for that accepted portion of the work.

E. Any workmanship, materials, or equipment proving to be defective during this guarantee period shall be made good by this contractor without additional cost to the Owner.

1.25 CONTEMPLATED WORK

A. The work contemplated occurs on the site of and within the existing building.

B. The drawings and specifications for the mechanical and electrical portion of this project have been prepared by Motz Consulting Engineers, Inc., doing business as Motz Engineering.

C. The various items of work necessary for completion of this work are hereinafter specified under the respective section headings or shown on accompanying drawings, and shall be included in any contract or contracts made for completion of respective divisions of the work. Such contracts shall also include necessary details reasonably incidental to the proper execution and completion of such work.

1.26 PROCEDURE

A. The building will be in operation during the progress of this work. Prime Contractor and all subcontractors shall arrange their work so there will be no interruption to the Owner's business nor prevention of vehicular access to all portions of his property. All work shall be carried on as quietly as possible in a manner approved by the Engineer and Owner.

B. The following fire safety procedures shall be followed:

1. Fire Warden: Each contractor's job superintendent shall be appointed as fire warden, who shall be responsible for maintaining the fire safety procedures, hereinafter specified.

2. Portable Fire Extinguishers: The contractor will furnish portable fire extinguishers for their use. Contractors shall locate extinguishers near all welding and cutting operations and in all other areas where fire hazards exist from demolition and/or construction operations.

3. Access: Free access shall be maintained at all times to all permanent and temporary fire suppression equipment.

4. Exits: Clear means of egress shall be maintained at all times.

5. Welding and Cutting:

a. Equipment shall be maintained in good condition. Tanks shall be stored outside building whenever practical in areas free from combustible materials and direct sunshine. Tanks inside building shall be located at no greater distance from work area than is necessary for safety.

b. Operations shall be performed outside whenever practical and whenever possible; equipment not in use shall be stored outside. Operations performed inside the building within 10 feet of combustible materials shall have a

noncombustible shield. Suitable fire suppression equipment shall be available in the work areas. At the conclusion of work, including lunch break and at end of day, work area shall be inspected twice at 15 minute intervals for any smoldering embers or live sparks.

6. Material Storage

   a. Flammable liquids shall not be mixed inside building nor shall flammable liquids within their own container be stored within 20 feet of the building. Flammable liquids stored inside the building shall be limited to 60 gallons and must be stored in approved storage cabinets.

   b. Covers over stored material shall be flame proof.

7. Temporary Partition: Partitions shall be constructed of fire retardant materials. Provide barriers as required to keep people and vehicles away from hazardous conditions. Provide temporary dust proof partitions between areas in which remodeling work occurs and occupied adjacent areas. Required exitways must be maintained as directed by the Owner.

   a. Scaffolding: Scaffolding materials shall be noncombustible.

   b. Rubbish Removal: Rubbish, debris, packing materials, etc. shall be removed from the building daily.

   c. Temporary Office and Tool Storage: Facilities located inside the building shall be noncombustible. Facilities located outside building shall be of noncombustible material or shall be located more than 30 feet from the building.

   d. General

      (1) Smoking: No smoking will be permitted within this building.

      (2) Dirt, Dust, and Vapors:

         (a) Dirt, dust, or vapors can disrupt and damage University equipment. For any operations producing dirt, dust, lint, filing, or airborne microscopic particles/vapors, arrangements must be made to contain the contaminants at their source.

         (b) Operations performed inside building shall be performed within a mechanical room whenever possible; work performed outside these areas, when necessary, shall be performed only after receipt of Owner's approval.

         (c) During any cutting or drilling of any holes (wet or dry), a vacuum cleaner shall be operated in the area of the work in order to remove dirt and dust. A thorough clean-up shall be accomplished immediately after cutting or drilling each hole.

1.27 MOVING MATERIALS

A. If it becomes necessary at any time during the progress of this work to move materials

which have been temporarily located and which are to enter into the final construction, the contractor furnishing said materials shall, when so directed by the Engineer, move them or cause them to be moved. Cost of such moving shall be included in the contract price

1.28 ACCIDENT PREVENTION

A. Precaution shall be exercised at all times for the protection of persons and property. The safety provisions of applicable law, building, and construction codes shall be observed. Machinery, equipment, and other hazards shall be guarded in accordance with safety provisions of the "Manual of Accident Prevention in Construction" published by Associated General Contractors of America to the extent that such provisions are not inconsistent with applicable law or regulations.

1.29 TOOLS AND MATERIALS

A. Tools and materials shall be stored on the premises at locations designated by the Owner.

1.30 PROPERTY PROTECTION

A. All hoisting shall be done with proper tag lines and buffers to prevent damage to the sides of the building. Where it is necessary to hoist materials to the roof, the parapets at top of the building and the roof where materials are landed from hoists shall be protected with heavy wood covers. Parapet protection shall be placed on both sides and top, and shall extend far enough on either side of landing point to insure adequate cover. The roof, from the landing point at parapet to final location of material, shall be adequately protected by planks laid side by side on roofing and spiked together on outside edges with planks running at right angles to main planking. The roof shall be adequately protected against leaks at all times.

B. Where hoists are erected on the roof for hoisting material up the side of the building, the roof shall be adequately protected against abrasion or other damage. Materials stored on the roof shall be placed on planks or other protection approved by the Engineer and shall be placed only at locations approved by the Engineer.

C. If hoisted materials are taken through windows, the jams, head, and sill shall be adequately protected with wood planking or proper buffers.

D. Any work, equipment, or property damaged during construction of this project and due to operations under this contract shall be repaired or replaced by this contractor, without additional cost to the Owner. Upon completion of the work, the contractor shall remove all protections herein specified.

1.31 REMOVAL OF RUBBISH

A. It shall be each contractor's duty to keep the building and surrounding premises clean, free from rubbish of every description. No rubbish, crating materials, packing, or dirt shall be allowed to accumulate at any time, but shall be removed at once and hauled away.

B. Each trade shall be responsible for its own tools and materials during the periods of rubbish removal but contractors shall use reasonable care in removal of rubbish to protect the tools and materials of others against loss or damage. The Owner reserves the right, in the event that removal of rubbish is not promptly and properly carried out by the Contractors to have rubbish removed and to charge the cost of its removal to the contractor.

C. Also, refer to Division 00.

1.32 MATERIAL SAFETY DATA SHEETS (MSDS)

A. The contractor shall obtain and maintain on-site during the course of the project the Material Safety Data Sheets (MSDS's) for all chemicals or products containing chemicals that may be considered toxic or hazardous. The MSDS's are to be forwarded to the Office of Environmental Health and Safety upon completion of the project.

1.33 COORDINATION DRAWINGS

A. Refer to Section 230400

1.34 ELECTRONIC FILES OF ENGINEERING DRAWINGS

A. The AutoCAD Drawings will be provided to each contractor upon executing a disclaimer provided by the Architect and/or the Engineer.

B. Refer to Division 01.

1.35 INSTRUCTION OF PERSONNEL

A. The Integrated Automation Subcontractor shall provide free on site instruction in the proper use of installed equipment to designated representatives of the Owner, sufficient to ensure safe, secure, efficient, non-failing utilization, and operation of systems. This instruction shall include the following:

1. One Site Training: Provide a minimum of 24 hours of training for owner's staff. Submit a syllabus to the Engineer prior to the first session.

2. Support: Provide a minimum of 16 hours of support either on site or by telephone to answer operations questions.

3. Manufacturer's Factory Training: Refer to Section 25 05 10.

PART 2 – NOT USED

PART 3 – NOT USED

END OF SECTION 25 04 00

SECTION 25 05 10 – DIRECT DIGITAL CONTROL SYSTEM (DDC)

PART 1 - GENERAL

1.1 SUMMARY

A. This contract shall include the furnishing of all labor and materials required for the installation of new temperature regulating systems in the building addition to monitor, control, and regulate automatically and completely the new air conditioning, ventilating, hydronic and heating systems, as shown on the accompanying drawings and hereinafter specified. The temperature control equipment shall be installed by trained mechanics and technicians employed by the manufacturer and working in conjunction with the other contractors.

B. Bids for the temperature control work, hereinafter specified, shall be based upon a Siemens direct digital control system with electronic sensors for indication and control functions, electronically actuated devices including new dampers, valves, etc., and all connections to sensors and actuated devices. The DDC system for this project shall be fully integrated into the existing MU Campus System, such that complete control, monitoring, programming, reporting of alarms, etc. can be performed from any of the existing workstations. This integration shall provide BACnet Level 6 capability. All bidders of controls shall submit to Engineer, prior to bid date, a complete brochure containing literature covering each item of control, and identifying its application. Prior to award of contract, bidders may also be required to furnish preliminary temperature control layout drawings and description of operation of same.

C. The existing building Siemens control software shall be upgraded so that it is identical to the software being utilized for this project. The software for the entire system including existing operator workstation shall also be upgraded at the end of the warranty period. The existing server shall be upgraded as required by the University to facilitate the building addition scope of work.

D. Where existing systems are not specifically mentioned in this specification, they shall remain, as is. Contractor will not be responsible for proper operation of existing controls.

E. The new systems shall be complete with all piping connections, switches, relays, certain wiring, or other devices required to accomplish the required results. All control devices shall be of the manufacturer's best construction and of positive positioning type where mixing is required. Complete shop drawings of the control system shall be submitted for approval. Contractor shall become thoroughly familiar with interconnections, with equipment specified under other sections of this specification including electric work, and all work furnished by the Direct Digital Control Contractor shall be coordinated therewith.

F. The DDC system for this project shall be fully integrated into the existing XAVIER campus Siemens Direct Digital Control system. This integration shall be performed in a manner that complete control, monitoring, alarming, trending, scheduling and graphics for all input/output points required for this project can be performed from any of the existing Ethernet workstations connected to both management level network and to the servers. All additions to the Digital Control System shall be through a direct connection over the University’s Ethernet network.

G. Conformance and Specification: All BACnet devices and services supplied as part of this project shall conform strictly to the ASHRAE/ANSI BACnet standard. Any deviations,

limitations, or omissions when compared to the standard shall be fully outlined in writing as part of the required submittals.

H. The BACnet specification defines a comprehensive set of object types and applications services that exist at all levels of control in a distributed, hierarchical building automation system model. The specification defines the six “conformance classes” and the nine “functional groups” that must be met in order to conform to the full functionality of BACnet. Conformance classes are numbered 1-6 and are hierarchical in nature. The requirements for each class include all of the requirements of all of the upper classes with a lower number. Functional groups are collections of BACnet standard object types and applications services that collectively meet the communication requirements of a single building automation function.

I. BACnet Conformance Classes: All control system devices provided and installed shall strictly conform to the conformance classes defined under the current version of the BACnet protocol at the time of bidding. Any changes in the protocol from the time of award of contract through the end of the warranty period shall be provided and installed free of cost to the University. All BACnet devices supplied shall be able to initiate and execute service requests as indicated in each conformance class. Control system devices included in this project shall conform to conformance class one (1).

J. BACnet Functional Groups: All new digital system devices provided and installed shall conform to the requirements of current and future BACnet functional groups for all object types and control applications found in the I/O schedule in this specification.

1. The following BACnet functional groups shall be fully supported:

    a. Clock Functions
    b. Hand Held Workstation (HHWS)
    c. Personnel Computer (PCWS)
    d. Event Initiation
    e. Event Response
    f. Files
    g. Reinitialize
    h. Virtual Operator Interface
    i. Virtual Terminal

2. Protocol Implementation Conformance Statement: Each bidder shall submit a Protocol Implementation Conformance Statement (PICS), created by the BACnet device manufacturer which identifies the particular options implemented in each BACnet device supplied as part of this specification. The PICS supplied shall contain five (5) sections. The first section shall provide basic information to identify and describe each BACnet device. The second section shall enumerate the standard object types that are supported and shall indicated for each object type, whether only the standard properties are supported or if the optional services are supported and for each service indicate if the implementation can initiate the service request, respond to the service request, or both. The forth section shall enumerate the BACnet functional groups that are supported. The last section shall indicate the data link and physical layer options that are implemented.
3. Interface Responsibility: It shall be the control contractor’s responsibility to ensure that the BACnet interface between the existing Siemens control system network and the new digital controllers perform as specified. All new data points and control programs shall appear to the existing operators console as native points and shall interoperate with the existing system hardware and software so that all alarms, commands, set point adjustments, time schedules, point databases and controller programs are totally functional through the BACnet gateway interface. It shall be the contractor’s responsibility to map the new controller points and all functionality into the gateway.

1.2 MASTER OUTDOOR AIR CHANGEOVER CONTROLS

A. The existing master outdoor air changeover controls shall be expanded to control new systems installed as a part of this project. The existing DDC controller is programmed to perform the following seasonal changeover mode of operation for each air conditioning unit.

1. When the outside air enthalpy is less than return air enthalpy, each air conditioning unit shall operate in the “Economizer” or free-cooling mode of operation, wherein outside air is used to condition the space.
2. When the outside air enthalpy is greater than return air enthalpy, or when outside air temperature rises above 75°F (DDC adjustable), each air conditioning unit shall switch to “Non-Economizer” or mechanical cooling mode of operation, wherein chilled water is circulated to the cooling coil of the unit, and is used to condition the space.
3. The following changeover functions shall occur.
    a. For new Air Conditioning Unit, when supply fan is operating:
    b. Cause outdoor air and exhaust air dampers associated with Energy Recovery Wheel to open. Cause bypass outdoor air, return air, and bypass exhaust air dampers to be fully operational, during Economizer mode.
    c. Cause heating coil valve to be operational.
    d. Cause cooling coil valve to be operational during Non-Economizer mode and cause valve to close during Economizer mode.
    e. Cause Chilled Water Pump No. 1 or No. 2 to operate when either any ACU is operating and outdoor air temperature is above 50° F. (DDC adjustable).

1.3 CONTROLS FOR NEW AIR CONDITIONING UNIT AHU

A. New variable air volume Air Conditioning Unit AHU consisting of a supply fan and return fan will supply conditioned air to the building. The unit shall operate by schedule. An energy recovery wheel associated with ACU shall operate only when the outside air temperature is below 50° F., or above 75° F (DDC Adjustable). The energy recovery wheel shall not operate when the outside air temperature is between 50° F. and 75° F. A self-contained defrost package furnished with each energy recovery wheel, consisting of radiant heaters and an outside air thermostat, will, whenever ACU is operating, energize the heater when the outside air temperature falls below 11° F. to prevent frost buildup on the wheel. Variable frequency drives associated with supply fan and return fan will operate fans at varying speed settings to provide supply air static pressure at setpoint in ductwork.

B. Provide new controls, consisting of DDC controller, electronic sensors, etc., to monitor and control the system as indicated on the input/output schedule at the end of this section. For operation of controls, refer to the following paragraph.

C. Operation of Controls.

1. Fan operating cycle: DDC controller shall cause supply and return fans to operate continuously. When supply fan is operating, DDC controller shall perform the following functions.

    a. Cause outdoor air and exhaust air dampers associated with Energy Recovery Wheel to open. Permit bypass outdoor air, return air, and bypass exhaust air dampers to be operational during Economizer mode; close bypass outdoor air and

bypass exhaust air dampers and open return air dampers during Non-Economizer mode.

b. Permit energy recovery wheel to be operational, only as described herein.
c. Permit cooling coil valve to be operational only as described herein.
d. Permit heating coil valve to be operational only as described herein.
e. Permit supply fan and return fan speed control devices to be operational.
f. Permit zone terminal units to be operational.

2. Mixed Air Controls.

a. A manually inputted command at DDC controller shall permit manual closing of bypass outdoor air and exhaust air dampers and manual opening of return air dampers when supply fan is operating. Another manually inputted command shall permit manual emergency opening of bypass outdoor air and exhaust air dampers and manual closing of return air damper during Non-Economizer mode when supply fan is operating. When supply fan is indexed to "off" or when fans stop because of a fire condition, low temperature cutout condition or high supply air static pressure condition; DDC controller shall close outdoor air and exhaust air dampers and shall open return air dampers.
b. When air conditioning unit is operating in Economizer mode, DDC controller, receiving signals from mixed air and supply air temperature sensors, shall modulate bypass outdoor air, return air and bypass exhaust air dampers to maintain mixed air temperature at supply air temperature setpoint minus 2°F (DDC adjustable).
c. Air flow tracking operation: When air conditioning unit is operating, DDC controller, receiving signals from air flow monitoring stations located in the outdoor air, return air, and supply air plenums and zone occupancy sensors in all spaces shall begin to increase the percent open position of the outdoor air damper if necessary to maintain the outdoor air CFM ventilation requirement setpoint as calculated by ASHRAE 62-2010 multiple zone equation, using Owner's latest application of this standard.
d. Cooling coil valve controls: When supply fan is operating and outside air temperature is above 50° F, DDC controller, receiving signal from outside air temperature sensor and supply air temperature sensor shall modulate cooling coil valve to maintain present supply air temperature reset schedule based on outside air temperature. Supply air temperature shall be based on the following reset schedule (DDC adjustable). When supply fan is not operating, or outside air temperature falls below 50° F, DDC Controller shall close cooling coil valve.
e. Gas Duct Furnace controls: When supply fan is operating, DDC controller, receiving signal from outside air temperature sensor and supply air temperature sensor shall modulate furnace to maintain present supply air temperature reset schedule based on outside air temperature. Supply air temperature shall be based on the following reset schedule (DDC adjustable). When supply fan is not operating, or outside air temperature rises above 50°F DDC controller shall shut off furnace.

Outside Air Temperature	Supply Air Temperature
20°F	62°F
60°F	55°F

3. Fan speed controls:

a. When supply fan is operating, DDC controller, receiving signal from supply air static pressure sensor, shall vary supply fan speed in order to maintain static air pressure at setpoint in supply ductwork. In addition, DDC controller shall vary return fan speed based on supply fan speed and a fixed pressurization constant (5% of system total supply air) in order to cause return fan speed to track behind supply fan speed and thereby maintain a positive pressure within the building.
Formula: RA = SA - EA - general exhaust - fixed pressurization constant

b. Air conditioning unit supply air static pressure setpoint shall be reset from the initial programmed value based on the position of all VAV terminal unit dampers served by that unit. Static pressure setpoint shall be raised in increments of 0.05" WC every 5 minutes if 5% (DDC adjustable) of all VAV terminal dampers is at the 90% open or greater position (DDC adjustable). Static pressure setpoint shall be lowered in increments of 0.05" WC every five minutes when less than 5% of all VAV terminal unit dampers are less than 90% open position. Reset of static pressure setpoint shall be limited to the range of 0.5" WC to 1.5" WC (DDC adjustable).

4. Zone Controls:

a. All room variable air volume (VAV) terminal units shall use electronic damper valve actuators as specified in Section 233600. The damper/valve actuators shall move in a smooth, steady progression without overloading the actuator in any way. The Direct Digital Control Contractor shall be responsible for properly sizing actuators to the torque requirements of each terminal unit damper and reheat valve. The speed of the actuator shall be appropriate to the application so that the control loop may be easily tuned. The Sheet Metal Contractor shall be responsible for properly securing the actuator to the terminal box damper shaft. Electronic actuated valves shall be capable of being manually opened or closed.

b. Provide terminal equipment controllers (TEC's) as required for all variable air volume terminal boxes. Each TEC shall be a microprocessor based direct digital control unit and shall be capable of operating either as a stand-alone controller or on a multi-drop communications network originating at a direct digital controller at associated air handling unit direct digital controller. Provide each TEC with sufficient memory to operate independently supporting its own inputs and outputs, operating system, database and programs necessary to perform specified control sequences.

c. Provide an airflow sensor with multi-point, center averaging velocity sensors. The multi-point sensor shall provide a representative average of the box total air flow at the box discharge, regardless of air flow profiles, assuring an accurate signal to the controller. The controller shall modulate the terminal damper actuator from the minimum to maximum CFM set points specified for each VAV terminal box. Provide test port openings in flow sensor tubing for local manometer readings of differential pressure across the pitot tube. After the new TEC controller is installed, the Test and Balance (TAB) Contractor will measure the actual air volume through the terminals as part of the commissioning and acceptance process. The Direct Digital Control Contractor shall then adjust the volume indication at the controller to the actual volume found at both the minimum and maximum setpoint of the terminal box.

d. Each terminal equipment controller controlling space temperature shall be provided with a matching room temperature sensor. The sensor shall be an RTD providing the following minimum performance requirements:

1) Accuracy: 0.5 Degrees F.
2) Operating range: 35 Degrees F. to 115 Degrees F.
3) Setpoint range: 55 Degrees F to 95 Degrees F.

4) Modes: Occupied, Unoccupied, Heating, and Cooling.
5) Calibration adjustments: None.
6) Installation: Up to 100 ft. from controller.

e. Each room temperature sensor shall include a terminal jack integral to the sensor assembly. The terminal jack shall be used to connect a portable laptop or similar operator's terminal to control and monitor all hardware and software points associated with the controller.
f. The room temperature sensor shall include the following auxiliary devices:

1) Setpoint adjustment buttons dial.
2) LCD temperature indicator.
3) Occupied override pushbutton.

g. The setpoint adjustment dial or button shall allow for modification of the temperature setpoint by the occupant. Setpoint adjustment may be locked out, overridden or limited as to temperature or time of day through software by an authorized operator at an existing operator's workstation.
h. Each controller shall perform its primary control function independent of other digital controllers on the network, network communication, or if the network communication is interrupted.
i. Each controller shall include algorithms incorporating proportional, integral and derivative (PID) gains for all applications. All PID gains and biases shall be field adjustable by the user via a portable computer. Controllers that incorporate proportional, and integral (PI) control algorithms only, shall not be acceptable.
j. All user defined database information required for each terminal controller must be stored in the controller in non-volatile EEPROM or FLASH ROM. Terminal controller point/controller database information must also be stored at the direct digital controller to which terminal controller local area network is connected. The terminal controllers shall be able to return to full normal operation without user intervention after a power failure of unlimited duration.
k. Terminal controller's occupied/unoccupied setpoint shall be controlled by a dry contact located in the room's occupancy sensor(s) also used for direct control of room lighting. For rooms without occupancy sensors, room terminal controller shall be provided with a time of day schedule to allow for 365 day advanced scheduling of rooms HVAC operation, (e.g. for common class and office schedules). All room schedules shall be located in the direct digital controller also serving the rooms associated air handler.
l. Each terminal controller shall have connection provisions for a portable laptop computer similar to the connection provided at the room temperature sensor as previously specified. The terminal may be used for readout of system variables, override control, adjustment of control parameters, air balancing, servicing and troubleshooting. The Direct Digital Control Contractor shall provide three copies of the terminal control interface software required to communicate with the terminal controller.
m. All communications and displays via the portable computer shall be in full English with accompanying English and SI units.
n. Terminal controller hardware inputs/outputs required:

1) Analog inputs:

a) Terminal box discharge air velocity sensor.
b) Terminal box discharge air temperature sensor.
c) Room temperature sensor.
d) Room temperature setpoint dial.

2) Analog (or three-point floating) outputs:

a) Damper actuators.
b) Reheat valve actuator.

3) Digital inputs:

a) Occupied/Unoccupied switch-over signal (By room occupancy sensors dry relay contact).

o. Occupancy sensor and power packs:

1) Under another contract, the Electric Contractor will furnish all items of material, labor, conduit, wire, junction boxes, etc., necessary to furnish a completely operational occupancy sensor system to control room lighting and provide an occupied input signal to certain room VAV terminal controllers.
2) The occupancy sensor system shall be as manufactured by Watt-Stopper, or approved equal. The Electric Contractor shall submit complete shop drawings for approval. Submittals shall include occupancy sensor(s) layout for each room, relay power pack quantity and location, all wiring diagrams clearly marked, showing device location, orientation, and coverage of each sensor.
3) Electrical Wiring:

a) Electric Contractor: The Electric Contractor shall furnish and install the occupancy sensors, relay packs and all line voltage branch circuit conduit and wiring to directly control room lights. In addition, the Electric Contractor shall furnish all Class 2 control wiring between each occupancy sensor and its associated relay power packs.
b) Direct Digital Control (DDC) Contractor: The DDC Contractor shall extend a Class 2 control wiring input signal from a spare contact in each occupancy sensor to room VAV terminal controller for room occupied/unoccupied status.

5. Safety controls:

a. Smoke Sensor: If products of combustion are sensed by new air duct smoke sensors located in the return ducts of the ACU, a hard wired smoke shutdown control relay furnished and installed in the DDC panel shall perform the following:

1) Shut down the supply fan variable frequency controller.
2) Shut down the return fan variable frequency controller.
3) Disable the energy recovery wheel.
4) Close all outdoor air and exhaust air dampers and open the return air damper.
5) Shut down all associated exhaust fans.
6) Signal DDC of smoke condition.

b. High Static Pressure Cutout: If a high static air pressure condition is sensed by new static pressure device located in supply air duct of the ACU, a hardwired high pressure shutdown control relay furnished and installed in the DDC panel shall perform the following:

1) Shut down the supply fan variable frequency controller.

2) Shut down the return fan variable frequency controller.
3) Disable the energy recovery wheel.
4) Close all outdoor air and exhaust air dampers and open the return air damper.
5) Shut down all associated exhaust fans.
6) Signal DDC of high static pressure condition.

c. Low Temperature Cutout: If a low temperature of 40°F occurs at the inlet to the heating coil as sensed by low temperature protection thermostats by Direct Digital Contractor, a hardwired low temperature shutdown control relay furnished and installed in the DDC panel shall perform the following:

1) Shut down the supply fan variable frequency controller.
2) Shut down the return fan variable frequency controller.
3) Disable the energy recovery wheel.
4) Close all outdoor air and exhaust air dampers and open the return air damper.
5) Shut down all associated exhaust fans.
6) Signal DDC of low temperature condition.

1.4 DIRECT DIGITAL CONTROLLERS

A. Furnish, install, connect and program, requisite direct digital controllers. Bids shall be based on Siemens. All monitoring and controlling functions associated with ACU's, chilled water system and heating system shall be performed with the above described DDC controllers. DDC based variable air volume terminal and lighting control units (TEC) with multi-drop communications network may be utilized for individual room control of lighting and air conditioning functions.

B. Each controller shall be capable of performing the functions herein specified and energy management functions, supply air reset, economizer cycle, adaptive optimal start, duty cycling, and optimization program execution. Programs shall be built-in including algorithms for proportional, integral, and derivative control in any combination as needed. Adjustments to the controller shall include, but not be limited to: proportional, gain, and integral rate, the velocity and acceleration constants associated with incremental control, and on/off values of two position control. All setpoints shall be adjustable at DDC control panel. Each DDC control panel shall have the ability to override its controlled device throughout their entire operating range. Provide hand-off-auto operator override switches for all digital outputs and hand-off and graphic switches for all analog outputs. Switches shall be mounted either within the DDC Controller key-accessed enclosure, or externally mounted with each switch keyed to prevent unauthorized overrides. DDC Controllers shall monitor the status of all overrides and inform the operator that automatic control has been inhibited. DDC Controllers shall also collect override activity information for reports.

C. The DDC system shall be Web-based and interoperable using BACnet communications without the use of gateways except for gateways between higher level BACnet IP networks and lower level MS/TP application specific control networks or gateways to non BACnet equipment, (i.e. electrical equipment, Hart meters, VFD's). When gateways are incorporated into the design, the system shall be configured to provide complete exposure of all non-BACnet data to the web server. The web server and any connected browser shall be configured and licensed in such a way that permits a minimum of 25 simultaneous users. Manufacturer's products, including design, materials, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ANSI/ASHRAE 135, ANSI/ASHRAE 135.1, ASME B31.1 and NFPA 70, except as modified herein or indicated otherwise.

D. The existing MU campus BAS systems are manufactured by Siemens Building Technology Inc. (SBT). Servers for this system already exists on the campus Ethernet IP internet work. When making new additions to campus building systems, integrate new systems and devices into the Siemens servers. Upgrade existing server with the manufacturer's latest software release and add new system devices, objects, application programs, graphics and required system wide functionality (alarm and event notifications, COV subscriptions, schedules, trending, and device management requirements so that new facility provides complete and consistent operation with existing systems.)

E. Controls for a single mechanical system such as an air handling unit, boiler or chiller shall not be divided between two or more controllers. A single DDC controller shall manage functions for a single mechanical system using stand-alone processes in the controller.

F. Locate DDC controller cabinets where shown on the drawings. If not shown on the drawings, install in the most accessible space close to the controlled equipment.

G. With each DDC panel, furnish a transient surge protection device. Such protection will protect the DDC components from voltage spike on incoming 120 volt, A.C., power. Wiring within DDC panels of different voltages shall be isolated from each other.

H. The DDC controllers shall have a sufficient quantity of input and output points to perform the functions herein specified and each controller shall have 20% minimum spare point capacity in panel.

I. All relays shall be equipped with surge suppressor wired across relay coil.

1.5 VALVE ACTUATORS

A. Electronic valve actuators shall be manufactured by the valve manufacturer.

B. Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.

C. Modulating and two-position actuators shall be provided as required by the sequence of operations. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. The valve actuator shall be sized based on valve manufacturer’s recommendations for flow and pressure differential. All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations. The spring return feature shall permit normally open or normally closed positions of the valves, as required. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.

D. Modulating Actuators shall accept 24 VAC or VDC and 120 VAC power supply and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal, and may be used to provide true position indication.

1.6 CONTROL VALVES

A. All new valves, other than zone control valves, shall have plug-and-disc inner valve to insure modulation of flow, or such other features as the application demands, and shall be equipped with operators of sufficient power to insure tight-seating against the working pressures. Valves 2" and smaller shall have screwed bodies. Valves 2-1/2" and larger shall have iron bodies and flanged ends. Water valves shall be sized for an allowable 3 lb. pressure drop. All three-way valves 2-1/2" and larger shall have horizontal piping connections, shall be so constructed as to be serviced without removing valve from the pipe line, and shall be tight-closing. All zone control valves shall be characterized control valves with two way valves being pressure independent type.

B. Valves shall be of the following types:

1. All two-way zone control valves shall be the Belimo PICCV, Pressure Independent Characterized Control Valves.

    a. The control valves shall accurately control the flow from 0 to 100% full rated flow with an equal percentage flow characteristic. The flow shall not vary more than ±5% due to system pressure fluctuations across the valve with a minimum of 5 PSID across the valve.
    b. Forged brass body rated at no less than 400 PSI, chrome plated brass ball and stem, female NPT union ends, dual EPDM lubricated O-rings and TEFZEL characterizing disc.
    c. Combination of actuator and valve shall provide a minimum close-off pressure rating of 200 PSID.
    d. The control valve shall require no maintenance and shall not include replaceable cartridges.
    e. Proportional actuators shall be Multi-Function Technology as manufactured by Belimo Aircontrols (USA), Inc. Multi-turn actuators are NOT acceptable. Running time shall be 100 seconds independent of the flow setting while rotating a maximum of 90 degrees. A separate feedback wire shall be capable of providing a signal which indicates the valve position and flow rate.

2. All three-way zone control valves shall be Belimo CCV, Characterized Control Valves.

    a. A TEFZEL, flow-characterizing disc shall be installed in the control port of three-way valves. The valve trim shall utilize chrome plated brass ball and brass stem may be used for sizes 3/4" and smaller and stainless steel trim on larger valves.
    b. Valve bodies shall be nickel-plated, forged brass with female NPT threads. Bodies to 1-1/4" shall be rated at 600 psi and sizes 1-1/2" to 3" at 400 psi and minimum close off pressure shall be 200 psi.
    c. Characterized Control Valves™ shall have a self-aligning, blowout proof, brass stem with a dual EPDM O-ring packing design. Fiberglass reinforced Teflon seals shall be used.
    d. The valves shall have a four bolt mounting flange to provide a 4 position, field changeable, electronic actuator mounting arrangement.
    e. A non-metallic coupling, constructed of high temperature, continual use material shall provide a direct, mechanical connection between the valve body and actuator. The coupling shall be designed to provide thermal isolation and eliminate lateral and rotational stem forces. Vent hole shall be provided to reduce condensation build-up.

3. All valves at air handling units shall be Belimo, Johnson Controls, Inc., Honeywell, Inc., Siemens Building Technologies, Inc., Invensys Building Systems, Inc.

    a. Control Valves: Factory fabricated of type, body material and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
    b. Hydronic system globe valves shall have the following characteristics:

        1) NPS 2 and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc and screwed ends with backseating capacity repackable under pressure.

        2) NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends and renewable seat and disc.

        3) Internal Construction: Replaceable plugs and stainless-steel or brass seats.
        4) Sizing: 3-psig maximum pressure drop at design flow rate or the following:

            a) Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
            b) Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.

        5) Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
        6) Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.

1.7 DAMPER ACTUATORS

A. Actuators shall be of the push-pull or rotary type for modulating, 3-point floating, or 2-position control as required by the application. The actuator shall use an overload-proof synchronous motor or an electric motor with end switches to de-energize the motor at the end of the stroke limits. Control voltage shall be 24 VAC, 2-10 VDC, or 4-20 ma as required. Actuators shall be provided with spring return to the normal position where shown. Actuators shall have a position indicator for external indication of damper position and a manual override capability, which operates without disconnecting damper linkage.

B. VAV Terminal Actuators shall be of the rotary type capable of permanent stall operation without damage. The actuator shall also have adjustable stop for stroke limit. Actuators shall utilize metal housings with nickel steel gears, oil impregnated for lifetime operation, and fit directly over the damper shaft. The actuator shall be a separate device from the TEC for ease of servicing.

1.8 CONTROL DAMPERS

A. Furnish to the Sheet Metal Contractor for installation, all new automatic dampers where indicated on the drawings and herein specified and scheduled. All dampers shall be of the louver type, with each blade constructed of galvanized steel, crimped and then spot welded

together with No. 13 gauge galvanized rolled steel frames equipped with oil impregnated sintered iron bushings turning in nylon bearings and interlinkages, and shall be perfectly balanced and of parallel or proportioning type construction as required. A single damper shall have blades no longer than 48" and no higher than 72". Maximum damper blade width shall be 8". Frames of all dampers shall be hot dipped galvanized after fabrication.

B. Unless specifically approved otherwise, all dampers shall be constructed and factory inspected so that the leakage will not exceed 1% under normal operating conditions; dampers shall be equipped with replaceable butyl rubber seal installed along top, bottom, and sides of the frame and along both edges of each blade or shall be equipped with inflatable, reinforced neoprene rubber edge seal and spring loaded stainless steel side seals. Dampers shall be Johnson Controls Proportion-Aire, Pacific Air Products Pneumaseal CD-207, Penn Ventilator Co. OBD-9, Honeywell Moduflow, or equal low leakage dampers. Submit name of damper manufacturer and descriptive data for damper with bid.

C. The sizes given are for estimating purposes only and shall be accurately checked in the field before dampers are fabricated. Cutoff dampers shall be two-position (open or closed). All other automatic dampers shall be of the opposed blade type for automatic mixing or proportioning as shown. For size and number of dampers required, refer to drawings.

D. Motorized control dampers, unless otherwise specified elsewhere, shall have damper frames using 13 gauge galvanized steel. Damper blades shall be parallel or opposed as required and shall be as recommended by manufacturer for application.

1.9 SENSORS

A. Temperature Sensors: Temperature sensors shall be linear precision elements with ranges appropriate for each specific application.

B. The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

1. Room Temperature - $\pm$ .5° Accuracy
2. Duct Temperature - $\pm$ .5° Accuracy

C. Space (room) sensors shall be available with setpoint adjustment and override switch. Space sensor shall have a portable service tool jack.

D. Duct mounted averaging sensors shall utilize a sensing element incorporated in a copper capillary with a minimum length of 20 feet. The sensor shall be installed according to manufacture recommendation and looped and fastened at a minimum of every 36 inches.

E. Thermowells for all immersion sensors shall be stainless steel or brass as required for application.

F. Low Temperature Protection Thermostats: Shall be the manual reset type. The thermostat shall operate in response to the coldest one-foot length of the 20-foot sensing element, regardless of the temperatures at other parts of the element. The element shall be properly supported to cover the entire downstream side of the coil with a minimum of three loops. Separate thermostats shall be provided for each 25 square feet of coil face area or fraction

thereof. The capillary shall be filled with Freon 134a. The thermostat shall have a repeatability of ± 1 ° F.

G. Low Differential Air Pressure Applications (0” to 5” WC):

1. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
2. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:

    a. (0.00" - 5.00” WC) input differential pressure ranges.
    b. 4-20 mA output.
    c. Maintain accuracy up to 20 to 1 turndown ratio.
    d. Reference Accuracy: +0.2% of full span.

H. Water Differential Pressure Applications (0-100PSI):

1. The differential pressure transducer and transmitter shall be integrally contained in one unit. The output shall be 4-20ma (2 wire) for an input differential pressure of (0-100 PSID). The unit shall be a Rosemont Model 1151.
2. Refer to detail on drawings for mounting and piping of device.

I. Current Sensing Relays: Motor status indication, where shown on the plans, shall be sensed by Nielsen-Kuljian, Inc. Sentry 250 and SC250, Veris Industries, Inc., or approved equal, split core current sensors approved for use with variable frequency drives.

J. Humidity Sensors:

1. Humidity Sensors shall consist of an electronic measuring circuit and a capacitive humidity sensing element whose electrical capacitance changes according to the relative humidity of the ambient air.
2. The electronic measuring circuit shall convert the sensor’s signal to a continuous 0 to 10 VDC or 4 - 20 ma signal which shall correspond to 0-100% relative humidity.
3. The accuracy of the sensor shall be +/- 2% over the range of 0 - 95% RH.
4. The sensor shall be suitable for duct mounting. The sensor shall consist of the polycarbonate housing, printed circuit board, connection terminals, mounting flange and immersion rod with measuring probe.
5. 24 volt AC control power for the operation of the sensor shall originate at the DDC control panel. Power consumption of the sensor shall not exceed 1VA.

K. Control Relays:

1. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
2. Mounting bases shall be snap-mount.
3. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
4. Contacts shall be rated for 10 amps at 120VAC.
5. Relays shall have an integral indicator light and check button.

L. Electric Thermostats: Thermostats shall have SPDT contacts, switching at an adjustable setpoint with a range of 55 to 85 ° F.

M. Carbon Dioxide (CO2) – Commercial grade model by Honeywell, Telaire, Vaisala, Veris or approved equivalent. Duct vs. wall mount style to match application.

1. Carbon Dioxide Sensor and Transmitter: Single detectors using gold plated infrared (NDIR) waveguide technology with automatic background calibration and passive gas diffusion (no moving parts); suitable over a temperature range of 0 to 50 deg C , with continuous or averaged reading, 4- to 20-mA output; for wall or duct mounting. Unit suitable for 24 VAC/VDC 60 Hz with power consumption less than 1 watt average. Measuring range shall include 0 to 3000ppm.

1.10 AIR FLOW MONITORING

A. Air Conditioning Units shall be equipped with a TEK-AIR Systems Inc., Model IAQ-2000 or equal, central airflow monitoring system to directly measure supply and outdoor airflow rates. The entire system shall be furnished and installed, in accordance with approved shop drawings by the Direct Digital Control Contractor.

B. Each airflow monitoring system shall consist of a central processing monitor panel and transducer mounted in close proximity to each air conditioning unit and a requisite number of Series IAQ-Tek airflow and temperature sensing probes located in the outdoor air plenums and Series TFP-7000 airflow and temperature sensing probes located on the inlet sides of supply and return fans.

C. IAQ-2000 Outdoor Air Volume Measurement System:

1. System Accuracy (Velocity for 0.1" transducer):

   a. 1000 to 200 fpm: +/- 5% of reading
   b. 200 to 75 fpm: +/1 10% of reading

2. Probe and Transducer

   a. Operating temperature range: -40 to 120°F
   b. Air Velocity

      1) Discharge of Intake louver - 75 to 750 fpm.
      2) Free air, before damper - 100 to 1000 fpm.

3. Probe

   a. Material: PVC/ABS
   b. Fire Rating: UL-94-VO and UL-94-VB
   c. Size: 8.5" Dia., 7.5" depth.
   d. Tubing Connections: 1/4" barb fittings.

4. Transducer

   a. Enclosure: NEMA 4X watertight.
   b. Size: 6" W x 4.75" H x 3.5" D
   c. Tubing Connections: 1/4" barb fittings.

5. Monitor

a. Operating temperature range: 30 to 110°F.
b. Enclosure: NEMA 4X watertight.
c. Size: 9" W x 9.5" H x 3..5" D
d. Power Requirement: 24 VAC, 25 VA
e. Digital input for fan status: dry contact.
f. Analog Output: 4 - 20 ma into 0 - 600 ohm.
g. Display: LCD, 4 - 20 lines, backlit.
h. Communication: RS - 485, half-duplex.
i. Address: 0 - 255.

6. TFP-7000 Fan Inlet Probes

    a. Application: Vane-axial fans.
    b. Probe material: Aluminum, 3/4" dia.
    c. Probe mounting: integral mounting brackets and safety cables.
    d. Velocity: 9550 fpm
    e. Range: 0 - 10" WC
    f. Probe accuracy: 3% of reading
    g. Connections: 1/4" barb fittings.

D. Quantity/Locations: Quantities and locations of sensors will be as indicated on shop drawings. Sensors will be provided for each duct for outdoor air, supply air, and return air.

1.11 WORK BY OTHERS

A. The HVAC Contractor shall install all thermo-wells, valves, dampers, and air flow monitoring stations as shown on the drawings or specified herein.

B. The Electric Contractor shall install all variable frequency drives furnished by the HVAC Contractor as shown on the drawings or specified herein.

C. The Electrical Contractor shall provide all power wiring (120 VAC and above) to all building control panels and shall provide mounting and power to all 120/24 VAC control transformers for VAV terminal equipment controllers.

D. The Electrical Contractor shall furnish and install the lighting control system. Provide mounting and power to all occupancy sensors, relay power packs interface devices, override pushbuttons, conduit and wiring, all in accordance with complete shop drawing layout furnished by the lighting control manufacturer.

E. The Electric Contractor shall furnish and install an Ethernet Data Jack in close proximity to each building control panel for connection to a laptop PC.

1.12 ELECTRIC CONNECTIONS

A. Where indicated, the Direct Digital Control Contractor shall provide the following:

1. Requisite DDC controllers, complete with all components needed for connection to remote input and output devices.
2. All internal wiring connections between devices in DDC equipment.
3. All electrical connections in DDC equipment from remote sensors, etc.
4. All network cabling between communication closets, risers and all DDC system BACnet building controllers BACnet application specific controllers, variable frequency drives, operator workstations, routers, switches, and hubs.

B. All other conduit and wiring required to make the system operate, including connections to remote indicating devices and sensors and including connections at DDC panels, shall be furnished and installed by the Digital Control Contractor, and this work shall comply with applicable requirements of the electric specifications. Each signal cable shall consist of

individually color-coded conductors terminated on terminals in DDC panel in a workmanlike manner. Wiring shall include all wires necessary for address command, digital status, analog value data acquisition, etc. Each end of each conductor shall have identifying number. The Direct Digital Control Contractor shall furnish a complete wiring diagram showing electrical connections to all items of equipment furnished under this bid.

C. Color coding for all Class 2 low voltage control cables shall meet the Xavier University Color Code Requirements:

1.	24 VAC Power/Signal:	Red/White
2.	Digital Input:	Orange
3.	Digital Output:	Blue
4.	Analog Input:	Green
5.	Analog Output:	Yellow
6.	Thermostat Cable:	Gray

1.13 QUALITY ASSURANCE

A. DDC and systems and equipment shall be designed and installed, commissioned, and serviced by either manufacturer-employed or factory-authorized dealer-factory-trained personnel. The manufacturer shall have an in-place support facility within 100 miles of the site with technical staff, documentation, spare parts inventory, and necessary test and diagnostic equipment to support the installation. The installer shall have an established working relationship with the Control System manufacturer of not less than three years.

B. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer’s latest standard design that complies with the specification requirements. Spare parts shall be available for at least 5 years after completion of this contract.

C. It is the responsibility of the DDC Contractor to be familiar with all codes, rules, ordinances, and regulations of the Authority Having Jurisdiction (AHJ) and their interpretations, which are in effect.

D. All work, materials, and equipment shall comply with the rules, regulations, and all codes and ordinances of the local, state, and federal authorities having jurisdiction. Such codes, when more restrictive, shall take precedence over these plans and specifications. As a minimum, the installation shall comply with the current edition in effect 30 days prior to receipt of bids of the following codes:

1. National Electrical Code (NEC)
2. Ohio Building Code (All Sections)

E. The latest issue of applicable standards and recommended practices of the following agencies in effect and shall form a part of the specification to the extent each agency's relative standards or recommended practices apply to the Systems and their components as specified herein.

1. Federal Communications Commission (FCC)
2. American National Standards Institute (ANSI)
3. American Society of Mechanical Engineers (ASME)
4. Electronic Industries Association (EIA)
5. Institute of Electrical and Electronics Engineers (IEEE)

6. National Electrical Manufacturers Association (NEMA)
7. National Fire Protection Association (NFPA)
8. Underwriters Laboratories (UL)
9. Occupational Safety and Health Administration (OSHA)
10. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

F. DDC Contractor shall be solely responsible for compliance with all health and safety regulations, performance of the work in a safe and competent manner, and use of industry accepted installation procedures required for their work.

G. All systems, equipment, components, accessories, and installation hardware shall be new and free from defects and shall be UL listed where applicable. All components shall be in current production and shall be a standard product of the system or device manufacturer. Refurbished or reconditioned components are unacceptable. Each component shall bear the make, model number, device tag number, and the UL label as applicable. All systems components of a given type shall be the product of the same manufacturer.

H. The manufacturer of the building automation system shall comply with ISO 9000 (Model for Quality Assurance in Production, Installation, and Servicing). The intent of this specification requirement is to ensure that the products from the manufacturer are delivered through a Quality System and Framework that will assure consistency in the products delivered for this project.

I. This system shall have a documented history of compatibility by design for a minimum of 2 years. Future compatibility shall be supported for no less than 10 years Compatibility shall be defined as the ability to upgrade existing field panels and extend new field panels on a previously installed network.

J. The system shall be commissioned in accordance with Section 230800, DDC pre-functional and functional check lists, and all manufactures commissioning guides and associated check lists. System trend logs with collection frequencies, COV values and trend frequencies as detailed on the DDC commissioning forms shall record all system performance for at least 2 full months prior to request for final acceptance in order to provide verification of accuracy and performance goals. DDC contractor shall provide analysis and written feedback on trend logs indicating any abnormal conditions or punch list items contained in trend log data delivered to the Engineer and Owners Commissioning agent.

1.14 SUBMITTALS

A. Submit manufacturers' specification sheets for each type of equipment to show compliance with the project specification. Highlight each compliance item and reference each item to the relevant specification paragraph number. Submit sufficient manufacturers' information to allow verification of compliance by the reviewing authority. Equipment and software specification compliance data submitted includes, but is not limited to, the following:

1. Product data on all components used to meet the requirements of the specifications such as enclosures, sensors, control devices, operators work stations (OWS's), routers, gateways, servers, all device product installation and user's manual documentation, configuration details such as object naming conventions, network numbering, device identification, device description, mounting details, power supplies, etc.
2. PICS Statements: Provide a complete set of descriptive and technical information on the BACnet communications capabilities of the proposed system. Each bidder shall submit a complete set of Protocol Implementation Conformance Statements (PICS) for all

hardware and software devices supplied by the BACnet device manufacture, which identifies the particular options, implemented in each BACnet device supplied as part of this specification. The PICS supplied shall contain five (5) sections. The first section shall provide basic information to identify and describe each BACnet device. The second section shall enumerate the standard object types that are supported. The third shall indicate for each object type, whether only the standard properties are supported or if the optional services are supported and for each service indicate if the implementation can initiate the service request, respond to the service request, or both. The fourth section shall enumerate the BACnet BIBBs that are supported. The last section shall indicate the data link and physical layer options that are implemented. In addition to the standard published PICS statements provided by the device manufacturer, prepare a spreadsheet containing a complete object by object property listing showing how each supported object property is implemented in each device. For each property, include its data type and range, and all applications services that can read, write, or manipulate the property. All control components and devices used on the project if currently listed by the BACnet Testing Laboratory (BTL) shall carry the mark of the BACnet Testing Labs. Tests performed shall be based on ASHRAE (Standard 135.1P) "Method of Test for Conformance to BACnet". All materials and equipment used shall be standard components, regularly manufactured for this and / or other system and not custom designed especially for this project. All systems and components shall have been thoroughly tested and proven in actual use for at least two years.

3. Provide to the owner, a complete software and engineering manual that contains system engineering information and technical documentation that supports the following:

    a. Complete device configuration and set up
    b. Complete device programming
    c. Service of all proposed control devices, including server, and operators work stations
    d. Operating systems software
    e. Application software
    f. Complete set of graphics application development software
    g. Web browser software listing (source code)
    h. Complete system database information including manufacturers users manuals, system schemas, RPC's, records, reports,
    i. Description of the user licenses (including numbers of simultaneous users) being proposed,
    j. Third part integration capabilities (note any required or additional software integration requirements by ATC manufacturer) and any required licenses, third party utilities and the proposed application programming manuals for each of the control devices proposed
    k. Clearly indicate where proposed owners documentation does not completely comply with this part of the specification.

4. The DDC Contractor shall submit AutoCAD generated schematic drawings for the entire control system for review and approval before work shall begin. The submittal shall include a bill of material reference list as well as equipment sequences of operation. A physical layout diagram showing the entire proposed building systems network architecture (include owners cable entry location, building control room (BCR), Telecommunications rooms (TR), equipment intermediate distribution frame (EIDF) room, cable risers, switch locations, horizontal cabling on each floor, horizontal connection points (HCP) to ATC equipment (Terminal Units), router locations, and each device (label all control devices and their ID's), BACnet device ID and location. Also refer to Paragraph 240500-23.
5. Submit temperature, lighting system and any other specified building systems physical layout diagrams for each air handling unit, terminal unit, chilled and heating water

system, exhaust, meter, or auxiliary equipment connection made at the point/object level. Indicate on layout each physical object (AI, AO, BI, BO) used for each input/output served by each control device.

6. Submit a complete set of sequences of operation for all controlled equipment and systems as required to meet specific project control sequences of operation and system interoperability.

B. Record “As Built” Submittals

1. Submit final copies of as-built shop drawings. These final submittals shall reflect all field modifications and change orders required to complete the installation. Submittal drawings will include revised control diagrams, device panel layout drawings, revised sequences of operation, wiring diagrams, termination details, object / point’s schedules, total campus or building system network layouts, valve schedules, damper schedules and room schedules. Drawings shall be "B" sized 11 inches x 17inches. Submittal brochures will include both a hard copy and an electronic copy in PDF format detailing all product data sheets on all control devices and associated equipment. As part of the as-built drawings, the DDC Contractor will provide a network riser and detailed floor plans showing horizontal detailed routing of all DDC and (and other specified building system devices) networked communication cables along with each devices I/O analog sensor wires, control or status input devices. Provide these with the control device locations, and communication trunk routing, each of the actual sensor locations shown on them.
2. In addition, contractor shall also provide a redline drawing indicating cabling paths for network and 24 VAC power.
3. Submit four (4) complete sets of submittal documents in a three-ring notebook and organized by subject with divider tabs.
4. Submit four (4) electronic copies of all submittal documents in Printed Document Format (PDF) on Compact Disks (CD’s).

1.15 FUNCTIONAL PERFORMANCE TESTS

A. The Functional Performance test (FPT) shall be executed by the Contractor and approved by the University. Use FPT sample procedures, designated by the Commissioning Agent, as a guide to creating the test plan spreadsheets.

1. Obtain written approval of the Functional Performance Test plan for testing before beginning any of testing. Give the Commissioning Agent written notification of planned testing at least 30 days prior to the test but not before completion of any test and balance (TAB) requirements have been completed. Notification shall be accompanied by the proposed test procedure, a verified Pre-performance Testing Checklist, and a written estimated time table required to perform the test. After the written notification is received, the Commissioning Agent shall convene a meeting with the Contractor and the Owner at least 14 days prior to testing. In no case will the Contractor be allowed to start testing without written University approval of the Functional Performance Test plan.
2. Demonstrate compliance of the heating, ventilating, and air conditioning control system with the contract documents including proper labeling of controls and wiring. Furnish personnel, equipment, instrumentation, and supplies necessary to perform calibration and site testing. Ensure that test personnel are regularly employed in the testing and calibration of DDC systems.
3. Functional Performance testing will include, but not be limited to, workstation operations, calibration results for input and output devices required by manufacturer, proper tuning of control loops, and ensuring proper execution of the sequence of operation. Use the

BACnet protocol analyzer during the performance testing to demonstrate communications reliability.

B. The Pre-performance Testing Checklist shall be used as the Contractor's guide to prepare for the FPT and to guide discussions at the pre-performance test meeting between the Contractor and the University. Every item on the check list shall be validated by the Contractor's QC representative prior to the test meeting.

1. Verify all workstations, notebook computers, and maintenance personnel interface tools have been delivered, all system and database software installed, and graphic pages created for each workstation and notebook computers. Notify the University when phone lines or network connections are needed at least 30 days prior to installation of the workstation.
2. Verify integrity/safety of all electrical connections.
3. Verify proper interface with fire alarm system.
4. Verify proper communications over network segments and between controllers.
5. Verify proper wire and control panel labeling.
6. Co-ordinate with TAB contractor to obtain control settings that are determined from balancing procedures.
7. Test, calibrate, and set all digital and analog sensing and actuating devices as required.
8. Check and set zero and span adjustments for all actuating devices as required.
9. Check each digital controller for stand-alone operation by temporarily removing from the network.
10. Check proper sequences have been installed and tested.
11. Check all control loops have been properly tuned.
12. Check all alarms are programmed and routed to their proper destination.
13. Check all trends are operating for each item marked for trending on the points list.
14. Check all schedules are operating for each item marked for schedules on the points list.
15. Complete all "as-built" record drawings and I/O points list.

C. The test procedure reporting documents shall be developed by the Contractor and based specifically on the control system installed in a spread sheet format allowing sufficient space for individual testing of each area of the control system. List the test procedure and the expected response for each piece of equipment and system in each test area specified. Develop a separate row or column for each item that is required to be "demonstrated" within a test area. Allow ample space for comments, pass, fail, and retest lines. Each area of testing shall have four signature lines, one for the Contractor's QC representative, the Contractor's FPT administrator, the Commissioning Agent representative, and the Owner to acknowledge successful completion for each test area. Include references to the paragraph number or drawing number in the contract documents for each item or group of items to be tested. BACnet protocol analyzer test results shall be included with the test reporting. During and after completion of the Functional Performance Test, identify, determine causes, replace, repair or calibrate equipment that fails to meet the specification, and submit a written report to the University.

D. Document all tests with detailed test results. Explain in detail the nature of each failure and corrective action taken. Provide a written report containing test documentation after the Functional Performance Test. Schedule a meeting with the Owner to present the results to the University after all failures have been corrected. Based on the report and test review meeting, the University will determine the successful completion of the testing. If retesting of any portion of the FPT is required, do not retest until after receipt of written notification by the University. At the conclusion of retest, assessment will be repeated. The University reserves the right to require retesting of 100 percent on every component in the system when results from sampled areas are found deficient. Final test results will be submitted in electronic format on CD media.

E. Using the completed shop drawings and the FPT spreadsheet, conduct the performance verification test to demonstrate workstations and network communications are operating correctly, control system maintains set points, control loops are tuned, and controllers are programmed for the correct sequence of operation. The test report shall include the required four authorization signatures for successful completion of each test area. Test areas may have several sub-areas and each shall be fully satisfied to receive approval. Partial completion cannot be signed off. Random sampling may be used for certain test areas that have identical hardware and control sequences at the discretion of the University. These test areas, when allowed, are preceded with the statement "*Ten percent sample testing allowed in this area for terminal zones that use identical controllers and sequences.*" If this statement is not found in the following test areas, the contractor shall assume that testing is at the 100 percent level for every terminal zone. When random sampling is allowed, the University will choose which items to test from the contract drawings. Allow for this when creating spreadsheets to insert the name and location on-site for random selection. Specifically the FPT consists of the individual test areas below and shall demonstrate the following:

F. Controller Capability, Accessibility, and Labeling

1. Memory: Demonstrate that programmed data, parameters, and trend/alarm history collected during normal operation is not lost due to power failures.
2. Direct Connect Interface: Demonstrate the ability to connect directly to each type of digital controller with a notebook computer. Demonstrate that maintenance personnel interface tools perform as specified in the Manufacturer's technical literature.
3. Wiring and AC Power: Demonstrate the ability to disconnect any controller safely from its power source using the AC Power Table.
4. Demonstrate the ability to match wiring labels easily with the control drawings. Demonstrate the ability to locate a controller's location using the riser communications diagram in the control drawings.
5. Nameplates and Tags: Demonstrate the nameplates and tags bearing device unique identifiers are accurate and permanently attached to HVAC the control panel doors and back plates. Demonstrate that plastic or metal tags have the correct equipment name and point identifier.

G. Workstation and Software Operation

1. For existing operators' workstation (OWS):

    a. Verify that the correct software has been installed and licensed with the latest revisions available, delivery of all associated peripheral components are installed correctly, CD installation media including system restore disks are delivered, and the on-site warranty has been properly registered with the manufacturer. For each existing user workstation or notebook computer specified for upgrade, verify that all hardware and software upgrades have been installed and licensed correctly.
    b. Demonstrate that point's lists are generated as specified and conform to the proper naming conventions.
    c. Demonstrate that graphics are complete, resolution size fills the workstation or notebook computer screen areas without scrolling and the operator can navigate successfully to every mechanical system and zone.
    d. Demonstrate the UPS backup maintains power for the specified time on the workstation during a power failure and can recover automatically after an extended power loss when the UPS battery has drained.
    e. Also, update all software at the conclusion of the warranty period for the existing operators' workstation and the new notebook.

H. BACnet Communications and Interoperability Areas

1. Demonstrate proper functioning of the five interoperability areas of data sharing, alarm and event management, trending, scheduling, and device and network management. Use the BACnet protocol analyzer to demonstrate that communications are free from errors and that devices from different manufacturers are interoperable. These requirements shall be met even if there is only one manufacturer's equipment installed.

I. Data Sharing

1. Data Presentation - On each web server workstation, demonstrate graphic display capabilities as follows: Each graphic page shall initially display with current data within 5 seconds over a web-based browser connection and 15 seconds after a dial-up modem connection is established. Updated information shall occur when a change of value (COV) notification is received or, if COV is not implemented, within 15 seconds. Demonstrate that any data value from any networked device shall be available for plotting at a workstation in real time. Select binary and analog data concurrently and plot multiple instances of each data type on the same screen. Demonstrate the ability to select sampling intervals from 10 seconds to 60 minutes. For devices that implement COV reporting, select this as the means to update the plot.
2. Monitoring of Any Property - Demonstrate the ability to display any value of any property of any object from any networked device including all properties required by BACnet, all supported optional properties, and any proprietary extensions. Compare the difference between properties shown on the operator workstation over the network and the properties shown when directly connected to the controller in the field.
3. Set point and Parameter Modifications - Demonstrate the ability to modify all control loop set points and tuning parameters via BACnet messages initiated through operator interaction with graphics displays. Compare the difference between parameters modified on the operator workstation over the network and the parameters modified when directly connected to the controller in the field.
4. Peer-to-Peer Data Dependencies - Demonstrate all BACnet devices are installed and configured to exchange data values directly, without the need for operator or workstation intervention, to implement the sequence of operations specified in the mechanical system drawings and to share global data values.

J. Alarm and Event Management

1. Alarm Lists - Demonstrate that alarms are installed and configured to detect alarms and events for the points indicated in the system drawings and are prioritized according to the standardized list designated by the Owner. Demonstrate system alarms, such as offline controllers are generated. Demonstrate software logic has been set up to avoid nuisance alarms, e.g., no temperature or status alarms shall be generated when fan systems are not running, or during start-up and shut-down transitions. Demonstrate that delays between the occurrence of an alarm condition and its annunciation are adjustable. Demonstrate alarms appear at any local workstation within 5 seconds over a web-based browser connection and 15 seconds on a dial-up modem connection. Demonstrate workstations display an alarm message window that appears on top of any other open windows and alarm message window has a distinctive color and appearance to attract the operator's attention. Demonstrate alarms that require operator acknowledgment and cause the alarm window to remain active until such an acknowledgment is received and when multiple alarms are received, unacknowledged alarms shall be displayed on a first-come first-served basis grouped by priority, with the highest priority alarms displayed first.
2. Alarm Parameter Adjustment - Demonstrate the ability for operators (with sufficient privilege) to change alarm parameters for all standard BACnet event types.
3. Alarm Routing Adjustment - Demonstrate the ability for operators (with sufficient privilege) to change alarm routing (BACnet notification classes) for each alarm including

the destination for each type of alarm and alarm priority, the day of week and time of day, and the type of transition involved (TO-OFFNORMAL, TO-NORMAL, etc.).

K. Scheduling

1. Schedule Lists - Demonstrate that schedules are installed and configured start/stop, mode change, and night setback schedules as defined in the sequence of operations including holidays. Demonstrate the ability to program alterations to programmed operating schedules based on the priority of events, including the ability to temporarily override the programmed schedule of equipment. Demonstrate operational override of a programmed schedule shall be for a specific duration following which the schedule shall revert back to the preprogrammed schedule.
2. Display of Start/Stop Times and Actions -Demonstrate the ability to inspect the content of any schedule and determine the specific control actions that will occur at any time, on any date.
3. Modification of Schedules - Demonstrate that all calendar entries and schedules shall be modifiable from any local workstation by an operator with sufficient privilege.

L. Trending

1. Archival Storage of Data - Demonstrate that archival storage of data will be handled by the operator workstation/server. Demonstrate that local trend archiving and display can be accomplished through the use of BACnet Trend Log objects.
2. Modification of Trend Log Parameters - Demonstrate that an operator with sufficient privilege shall be able to change the data points to be logged, the sampling rate, and the duration of a trend log.

M. Device and Network Management

1. Display of Device Status Information - Operators shall be able to display at any time the operational status of any device on the network.
2. Display of BACnet Object Information - Operators shall be able to display at any time any property of any BACnet object. Operators shall be able to display property values of objects grouped by object type, object location, and building system.
3. Silencing Devices that are Transmitting Erroneous Data -Operators shall be able to direct a field device to stop transmitting event, alarm, or COV notifications until a subsequent command to resume transmissions is received.
4. Time Synchronization - Operators shall be able to set the time and date in any device on the network that supports time-of-day functionality. The operator shall be able to select to set the time and date for an individual device or all devices on a single local network.
5. Remote Device Re-initialization - Operators shall have the ability to issue re-initialization commands to any device that supports remote reinitialization.
6. Backup and Restore - Operators shall have the ability to backup and restore all BACnet devices on the network that support this capability.

N. Execution of Sequence of Operation - Demonstrate the HVAC system operates properly through the complete sequence of operation. Insert the complete sequence of operation into the PVT spreadsheet with spaces between each line to allow for observations and comments.

O. Control Loop Stability and Accuracy - Furnish the University graphed trends of control loops to demonstrate the control loop is stable and that setpoint is maintained. Control loop response shall respond to setpoint changes of 10 percent and stabilize in 3 minutes or less. Control loop trend data shall be in real time and the time between data points shall not be greater than one minute.

P. Stand-alone Capability - Demonstrate stand-alone controller capability for each central mechanical system, each air handler, and each zone. Zones with identical controllers and

identical sequences may be randomly tested one controller per zone. Controllers shall provide stable and reliable stand-alone operation using default values or other method for values normally read over the network. Verify that a system alarm is generated indicating the communications failure for each controller in a stand-alone state.

Q. Refer to Section 25 08 00.

1.16 TRAINING

A. Submit syllabus, instructor's qualification statement, and all training materials (O&M and Course DDC manuals for each student) 45 calendar days prior to the start of training. Obtain written approval of the training course and instructor's qualifications before scheduling training. The Contractor shall request a meeting at least 30 calendar days prior to the start of training with the Commissioning Agent and the Owner to determining the training dates for course instruction to ensure availability of students and resolve any scheduling conflicts. Furnish a qualified instructor to conduct training courses for designated personnel in the maintenance and operation of the HVAC and DDC system. Instructor's qualifications shall include two years experience in the installation and programming of DDC systems and a minimum of 80 hours of experience providing instruction on the same manufacturer's equipment that is installed under this contract. Provide written documentation showing instructor's qualifications. Orient training to the specific system being installed under this contract. Use the Operation and Maintenance manual as the primary instructional aid. DDC training materials used by the manufacturer at the factory level shall be incorporated into the Operations and Maintenance manuals and provided on CD media. Manuals shall be delivered for each trainee with two additional sets delivered for archiving at the project site. Training manuals shall include an agenda, defined objectives, and a detailed description of the subject matter for each lesson. Furnish audio-visual equipment and all other training materials and supplies. A training day is defined as 8 hours of classroom or lab instruction, including two 15 minute breaks and excluding lunch time, Monday through Friday, during the daytime shift in effect at the training facility. For guidance, the Contractor should assume the attendees will have experience with DDC on other systems but not with the one installed under this contract. Training shall be provided with the goal in mind that each student shall acquire the skills to maintain the DDC system with the same professional skills as the installing manufacturer's representative.

B. DDC Training Phase I - The first class shall be taught for a period of three (3) consecutive training days at least 2 weeks prior to the scheduled Functional Performance Test. The first course shall be taught in a University provided facility on base or at the contractor's facility. Training shall be classroom, but have hands-on operation of similar digital controllers. A maximum of six (6) personnel will attend this course. Upon completion of this course, each student should be able to perform operations and describe the general hardware architecture and functionality of the system. This course shall include but not be limited to:

1. Using the Operation and Maintenance manuals
2. BACnet and communication architecture
3. Modifying setpoints
4. Adding and deleting I/O point
5. Writing application programs and creating graphics\
6. Data base backup
7. Trend reports
8. Alarm reporting and routing
9. Troubleshooting hardware and communication errors

C. DDC Training Phase II - The second course shall be taught in the field after the Functional Performance Test is complete, using the operating equipment at the project site for a total of two (2) consecutive days. A maximum of six (6) personnel will attend the course. The course shall consist of hands-on training under the constant monitoring of the instructor. The instructor shall determine the password issued to each student before each session. Upon completion of this course, students should be fully proficient in the operation of each system function. At this point the highest level password for complete access to the system will be issued. Each student who successfully meets the criteria of the course given will be given a certificate of satisfactory completion showing their name, course dates and the signature of instructor. Students who do not meet the minimum requirements of the course curriculum may be denied the certificate.

D. Manufacturer's Factory Training - Additional training shall be provided by the manufacturer at a factory training facility upon completion of site training for a maximum of up to five (5) days. A maximum of two (2) personnel will attend. The course shall be selected by the University from a list of standard catalog course offerings that are regularly scheduled and available to the end user. All costs associated with the factory training shall be included except for travel and per diem which will remain the responsibility of the University. Enrollment of the personnel attending factory training will be coordinated with the University and dates reserved based on course availability. Provide a confirmation letter within 10 days after the reservations have been made showing the training dates and reservations for the personnel who are attending. The University reserves the right to substitute personnel attending factory training at any time prior to the training dates. This training may be scheduled to take place up to six (6) months after the completion of all work provided the confirmation letter has been delivered.

1.17 ATTIC STOCK

A. The Direct Digital Control Contractor shall furnish and deliver to Owner, where directed, the following quantities of DDC components within thirty (30) days of substantial completion. Each item shall be new and in original carton.

B. Terminal Equipment Controller (Quantity: 1)

C. Temperature Sensor: (Quantity: 1)

D. Pressure Sensor-Air: (Quantity:1)

E. Pressure-High Static: (Quantity: 1)

F. Low Mixed Air Temperature Thermostat: (Quantity: 1)

G. Room Thermostat: (Quantity: 1)

1.18 GUARANTEE

A. The Direct Digital Control Contractor shall guarantee all workmanship and materials for a period one year from the date as defined in Section 25 04 00. Any defects in materials or workmanship occurring during this guarantee period shall be made good by this contractor without additional cost to the Owner.

1.19 PERFORMANCE GUARANTEE

A. In addition to the guarantee on workmanship and materials herein specified the Direct Digital Control Contractor shall guarantee the successful operation of all new equipment to automatically perform the functions specified with only periodical servicing and to operate the various dampers, valves, etc. in the manner specified to maintain conditions within 1° of the instrument setting.

1.20 SYSTEM INPUT/OUTPUT SCHEDULES

A. Refer to the following pages.

INPUT/OUTPUT SCHEDULE

System and Point Description	Input Point Type: Analog (AI) Measured: Temperature	Pressure	Rel. Humidy	% Speed	% Open	Pulse		Analog (AI) Calculated: Run Time	Enthalpy	Usage	CFM	Digital (DI): Failure	Status	Filter		BACnet	Output Point Type: 2 Position (DO): Off-On	Slow-Fast	Open-Close		Gradual (AO): Damper Position	Valve Position	% Speed		System Features: Alarms: Failure	Filter	Low Level	High Level	Low Analog Limit	High Analog Limit		Programs: Auto Lead Change	Stop/Start	Stop/Start (Opt)	Reset Schedule	DDC (PID)	Time Schedule	Astr Time Sched	Daylight Svgs Tm	Event Sequence		Pont of Indication on Color Graphic: Value/State	Alarm	Inhibit Mode	Test Mode	Manual Mode		Remarks
AHU																																															
Supply Fan																																																
Command: Off-On																■																							■								
Command: Speed																■																								■							0-100%
Status: Operate								■								■																															
Status: Failure																■									■																				■	■				
Status: Speed																■																															
Status: KWH										■						■																															
Return Fan																																															
Command: Off-On																■																															
Command: Speed																■																								■							0-100%
Status: Operate								■								■																															
Status: Failure																■									■																				■	■				
Status: Speed																■																															
Status: KWH										■						■																															
Energy Recovery Wheel																																															
Command: Off-On																	■																															
Command: Defrost																	■																															
Status: Operate								■					■																																		
Status: Failure																									■																				■	■				Note 1

Note 1: Failure alarm based on Digital Control - Digital Monitor Program (i.e., DDC not receiving proper status when commanding the device to operate)

INPUT/OUTPUT SCHEDULE

	Input Point Type																Output Point Type								System Features																	Pont of Indication on Color Graphic						
	Analog (AI)											Digital (DI)					2 Position (DO)				Gradual (AO)				Alarms							Programs																
	Measured							Calculated																																								
System and Point Description	Temperature	Pressure	Rel. Humidy	% Speed	% Open	Pulse		Run Time	Enthalpy	Usage	CFM	Failure	Status	Filter		BACnet	Off-On	Slow-Fast	Open-Close		Damper Position	Valve Position	% Speed		Failure	Filter	Low Level	High Level	Low Analog Limit	High Analog Limit		Auto Lead Change	Stop/Start	Stop/Start (Opt)	Reset Schedule	DDC (PID)	Time Schedule	Astr Time Sched	Daylight Svgs Tm	Event Sequence		Value/State	Alarm	Inhibit Mode	Test Mode	Manual Mode		Remarks
AHU-1A02 (Continued)																																																
Outside Air Temp	■																																									■						Global Point
Outdoor Air Humidity			■																																							■						Global Point
OA Enthalpy									■																																	■						Global Point
Supply Air Temp	■																												■	■												■	■	■				
Return Air Temp	■																												■	■												■	■	■				
Return Air Humidity			■																																							■						
RA Enthalpy									■																																	■						
ERU Exhaust Air Intake Temp	■																																									■						
ERU Exhaust Air Disch Temp	■																																									■						
ERU Outside Air Intake Temp	■																																									■						
ERU Outside Air Disch Temp	■																																									■						
Mixed Air Temp	■																												■													■	■					
OA/RA/EA Damper																					■															■						■						
ERU OA/EA Damper																					■															■						■						
Cooling Coil Valve																						■														■						■				■		
Cooling Coil Vlv Pos					■																																					■						
Gas Regulator																						■														■										■		
Supply Air Static Press		■																											■	■												■	■	■				
Dirty Filter		■																												■												■	■					
Airflow Monitoring																																																
Supply Air						■					■																															■						
Return Air						■					■																															■						
Outside Air						■					■																															■						

INPUT/OUTPUT SCHEDULE

	Input Point Type																Output Point Type								System Features																	Pont of Indication on Color Graphic						
	Analog (AI)											Digital (DI)					2 Position (DO)				Gradual (AO)				Alarms							Programs																
	Measured							Calculated																																								
System and Point Description	Temperature	Pressure	Rel. Humidy	% Speed	% Open	Pulse		Run Time	Enthalpy	Usage	CFM	Failure	Status	Filter		Hard Wired	Off-On	Slow-Fast	Open-Close		Damper Position	Valve Position	% Speed		Failure	Filter	Low Level	High Level	Low Analog Limit	High Analog Limit		Auto Lead Change	Stop/Start	Stop/Start (Opt)	Reset Schedule	DDC (PID)	Time Schedule	Astr Time Sched	Daylight Svgs Tm	Event Sequence		Value/State	Alarm	Inhibit Mode	Test Mode	Manual Mode		Remarks
AHU (Continued)																																																
Mixed Air Low Limit												■																														■	■					
Supply Air High Static												■																														■	■					
Smoke												■																														■	■					
Zone VAV Terminal Unit																																																QTY: 3
Occupied/Unoccupied													■																													■						
Heating/Cooling																	■																									■						
CFM											■																															■						
Room Temp	■																												■	■												■	■					
Room Temp Setpoint																																										■						
Re-Heat Valve																						■														■						■						
Re-Heat Valve Position					■																																					■						
Timed Override																																										■						
Discharge Air Temp.	■																												■	■												■	■					

INPUT/OUTPUT SCHEDULE

	Input Point Type																Output Point Type								System Features																				Pont of Indication on Color Graphic							
	Analog (AI)											Digital (DI)					2 Position (DO)				Gradual (AO)				Alarms							Programs																								
	Measured							Calculated																																															
System and Point Description	Temperature	Pressure	Rel. Humidy	% Speed	% Open	Pulse		Run Time	Enthalpy	Usage	GPM	Failure	Status	Filter		BACnet	Off-On	Slow-Fast	Open-Close		Damper Position	Valve Position	% Speed		Failure	Filter	Low Level	High Level	Low Analog Limit	High Analog Limit		Auto Lead Change	Stop/Start	Stop/Start (Opt)	Reset Schedule	DDC (PID)	Time Schedule	Astr Time Sched	Daylight Svgs Tm	Event Sequence		Value/State	Alarm	Inhibit Mode	Test Mode	Manual Mode		Remarks
Fuel Station																																																		

INPUT/OUTPUT SCHEDULE																																																
	Input Point Type																Output Point Type								System Features																	Pont of Indication on Color Graphic						
	Analog (AI)											Digital (DI)					2 Position (DO)				Gradual (AO)				Alarms							Programs																
	Measured							Calculated																																								
System and Point Description	Temperature	Pressure	Rel. Humidy	% Speed	% Open	Pulse		Run Time	Enthalpy	Usage	GPM	Failure	Status	Filter		BACnet	Off-On	Slow-Fast	Open-Close		Damper Position	Valve Position	% Speed		Failure	Filter	Low Level	High Level	Low Analog Limit	High Analog Limit		Auto Lead Change	Stop/Start	Stop/Start (Opt)	Reset Schedule	DDC (PID)	Time Schedule	Astr Time Sched	Daylight Svgs Tm	Event Sequence		Value/State	Alarm	Inhibit Mode	Test Mode	Manual Mode		Remarks
Fuel Station																																																

END OF SECTION 25 05 10

SECTION 260000 – ELECTRICAL WORK

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 a summary of all Electrical related work.

B. Related Sections:
1. 26 04 00 – GENERAL ELECTRICAL REQUIREMENTS
2. 26 05 00 – GENERAL ELECTRICAL PROVISIONS
5. 26 05 12 – ELECTRICAL POWERED EQUIPMENT
6. 26 05 19 – WIRES AND CABLES
7. 26 05 26 – GROUNDING AND BONDING
8. 26 05 29 – SUPPORTING DEVICES
9. 26 05 33 – RACEWAY AND BOXES
10. 26 05 34 – JUNCTION AND PULL BOXES
11. 26 05 35 – RACEWAY FITTINGS
12. 26 05 53 – ELECTRIC IDENTIFICATION
13. 26 08 00 – COMMISSIONING OF ELECTRICAL SYSTEMS
14. 26 09 23 – LIGHTING CONTROL DEVICES
15. 26 22 00 – LOW-VOLTAGE TRANSFORMER
16. 26 24 16 – BRANCH PANELBOARDS
17. 26 27 26 – WIRING DEVICES
18. 26 27 30 – TAPS, SPLICES, AND TERMINATIONS
19. 26 28 13 – FUSES
20. 26 28 16 – ENCLOSED SWITCHES
22. 26 29 23 – ADJUSTABLE FREQUENCY DRIVE
25. 26 51 00 – INTERIOR LIGHTING
26. 26 51 19 – LED INTERIOR LIGHTING
27. 26 52 19 – EMERGENCY AND EXIT LIGHTING
28. 26 56 00 – EXTERIOR LIGHTING
29. 26 56 19 – LED EXTERIOR LIGHTING

1.3 DESCRIPTION

A. The General Conditions, Special Conditions and Division 1 through Division 32, as set forth in these specifications, are hereby incorporated into and shall become a part of the specifications for work under this title, insofar as they apply hereto.

B. Furnish material, labor, tools, accessories and equipment to complete and leave ready for operation all Electrical systems for this project as described in these specifications and as shown on the drawings, or as required.

1.4 SCOPE OF WORK

A. Work includes, but is not limited to:

1. Furnish and install new panelboards and transformers. Extend new feeders as indicated on the drawings.
2. Furnish and install new variable frequency drives furnished by HVAC Contractor (AHU unit manufacturer). Extend new feeders as indicated on the drawings.
3. Extend new power branch circuits to all new mechanical equipment.
4. Provide certain new lighting fixtures and extend branch circuit wiring as indicated on the drawings.
5. Provide new emergency lighting system as indicated on the drawings. Provide manual transfer switch.
6. Provide new lighting control system consisting of relay panels, contactors, occupancy sensors, vacancy sensors, etc. and extend branch circuit wiring as indicated.
7. Provide new grounding system.
8. Remove certain existing convenience receptacles, provide new convenience receptacles and extend branch circuit wiring as indicated.
9. Modify and expand the existing fire and smoke detection and alarm system. Remove certain existing fire alarm devices in remodeled area. Provide new fire alarm devices in remodeled area and extend wiring as indicated. All existing fire alarm devices in remainder of building shall remain operational and shall become a part of the new fire alarm work.
10. Provide new access control and alarm system for certain exterior doors.
11. Provide communication and informational conduit system as indicated on the drawings.
12. Perform certain specialized Electric Work for the following other trades. Note, this listing is by no means meant to include each minute detail, but it is intended to alert the Electric Contractor to certain items. This contractor shall review each other division of work to ascertain the scope of electric work specified therein:
    a. General Contractor and Owner Furnished Equipment.
        1. Refrigerators, Freezers, Ice Machines, Microwave Ovens, Toasters, Office Equipment, etc.: Provide convenience outlets, where required for ease of connection to each item, and extend 120 volt connection thereto.
    b. Mechanical Equipment:
        1. Extend power branch circuit wiring to unit heaters, exhaust fans, air conditioning units, VAV terminal units, etc. as indicated on the drawing.
        2. Extend 120 volt dedicated circuit wiring to all DDC temperature control panel locations.
13. Perform start-up for all electrical systems and commission same in accordance with the commissioning requirement.
14. Provide and/or participate in training of Owner’s personnel on the use of all new electrical systems.
15. The contractor shall exercise adequate protective and safety measures for all persons and property and shall be responsible for any damages or injuries arising from the execution of this work.
16. Alterations and additions to existing work shall include the requisite dismantling of the old equipment, rigging, wrecking, hauling, protections of permanent equipment and the building structures, and cleaning up. Care shall be exercised to keep dust

and dirt to a minimum and to confine it to the area where the removal work is being performed. All debris shall be promptly removed.

17. If asbestos insulation is encountered on any existing wiring which is to be removed or remodeled, contractor shall immediately notify Owner of the existence of asbestos and Owner will arrange proper removal of same without cost to contractor.
18. Unless otherwise noted, remove all other existing equipment and piping, valves, fittings, etc. which will not be reused in the final arrangement. Unless otherwise noted, all items which will be removed by this this contractor and not reused shall become the property of the contractor and shall be promptly removed from the site by him.
19. The existing facility will be partially occupied and will remain in operation throughout the period that this work is being performed, and certain new work will be performed during this period. Unscheduled interruptions of the facility will not be tolerated. The contractor shall exercise extreme caution, shall thoroughly inform his workmen and subcontractors of the critical nature of this work, and shall continually review the work procedure being followed in order to prevent accidental interruption of service. Before performing any act which could result in interruption of service, the contractor shall notify the Owner and Engineer of the hazards involved and the contractor shall proceed in a manner and at a time specifically approved by the Owner and Engineer.
20. All work necessitating the temporary turning off or shutting down the operation of existing mechanical and/or electrical facilities shall be done at times specifically approved by the Owner and Engineer in advance of any disruption of existing facilities. Also, refer to Section 23 04 00 – General Electrical Requirements.

B. Demolition Work

1. Coordinate all Demolition with the University so that shutdowns occur at times agreeable to the University.
2. The Electric Contractor shall remove certain existing air handling systems. The existing plans are available for review at the Engineer's Office and the Owner will provide access to contractors desiring to verify existing conditions. The contractor shall be responsible to verify the extent of demolition work and shall include in their bid all demolition work affecting their trade.

1.5 EXCAVATION AND BACKFILLING AND RESTORATION OF SURFACES

A. Refer to Division 1 and Section 23 04 00.

1.6 EQUIPMENT

A. Any and all costs associated with piping, electric, wiring, conduit, supports, pads, or other modifications to accommodate installation for manufacturer's equipment that differs from equipment layout on drawings shall be included on contractor's bid. The contractor is responsible to insure that the equipment will fit within space allocated with appropriate clearances for maintenance, operation, servicing, and code.

1.7 DUKE ENERGY INCENTIVE PROGRAM

A. Comply with all requirements of the Duke Energy Incentive Program in order that the University will be able to obtain incentive monies from Duke Energy for this project. If Duke Energy requirements are more restrictive than the specifications, the Duke Energy requirements shall govern. A copy of the Duke Energy Incentive information for equipment is available on their web site. The contractor shall complete these forms, provide all requisite documentation, and present this information to the University for submission to Duke Energy. The incentive monies shall be solely available to the University.

1.8 QUALIFICATIONS

A. Installer: Company specializing in performing the work of this Section with minimum three years documented experience.

1.9 LICENSES

A. The installation of this Electrical work shall be made by Contractors and craftsmen licensed by the Governing Authorities.

B. Obtain all permits, plan revisions, inspections, and licenses required by code authorities having jurisdiction.

1.10 FEES

A. The Owner will obtain and pay for the building permit. The Contractor shall obtain all inspections or additional permits required by all laws, ordinances, rules, regulations or public authority having jurisdiction and obtain certificates of such inspections and permits and submit same to the Architect. The Contractor shall pay all fees, charges and other expenses in connection therein for Electric work including inspection fees, etc. associated with the building permit.

1.11 CODES, REGULATIONS AND STANDARDS

A. Unless otherwise noted, the following latest enforced Edition shall apply to this work:

Ohio Building Code
Life Safety Code
National Fire Protection Association
National Electrical Code
Ohio Fire Code
OSHA Requirements
EPA Requirements

1.12 QUALITY ASSURANCE

A. The Electrical Contractor shall be responsible for all costs caused by the change of equipment from the basis of design specified to other named manufacturers. The Contractor is responsible to insure that the other manufacturer named supplied equipment

will fit within space allocated, with appropriate clearances for maintenance, operation, service, code requirements, etc. Any contractor utilizing a manufacturer other than basis of design shall be responsible for any additional requirements for electrical service, concrete pad size, physical space limitations, and capacities at no additional cost to the building Owner. If manufacturers are listed, no other manufactures except those listed within the Sections of this Division, that are able to comply with the contract document requirements and minimum standards of these specifications, will be acceptable.

B. Work provided or performed by the Contractor shall be guaranteed to be replaced and made good at his own expense any defects which may develop, within one (1) year after final payment and acceptance by the building Owner, due to faulty workmanship or material, upon receipt of written notification of the defect from the building Owner.

1.13 COORDINATION DRAWINGS

A. General:

1. The HVAC Contractor shall be in charge of the coordination drawing process and shall be responsible to resolve all conflicts and settle any disputes resulting from the coordination drawing process.
2. Contract drawings are diagrammatic. Included in the base bid shall be all offsets, fittings, etc. for a completed project.
3. Field discrepancies shall be resolved by the field foreman. When discrepancies cannot be resolved, the signed-off coordination drawings shall be re-examined for rights.
4. Documented, coordinated, dimensioned work will have precedence. Owner will not pay for rework of a particular trade. Uncoordinated work will not be tolerated.
5. Coordination drawings shall be a phased process with the General Contractor, HVAC Contractor, Architect and Engineer determining the sequence of work.
6. Each Contractor shall coordinate the exact location of their work with the work of other trades prior to fabrication or installation of same. Verify all dimensions and elevations. Provide additional offsets and sections of material as may be required to meet the applicable job condition requirements. Coordinate with and review all related Construction Drawings and Shop Drawings of all equipment suppliers prior to start of work.
7. It is the responsibility of the Electric Contractor to coordinate between his equipment suppliers and his temperature control subcontractor and other subcontractors as to which control devices are supplied with equipment, required wiring and voltages, and other related coordination times, so as to ensure a complete, proper, and operable installation.

B. Process

1. The HVAC Contractor shall have precedence for the allotment of available space. Ductwork rerouting for gravity drain lines may be required and shall be approved by the Engineer.
2. The HVAC Contractor shall be responsible for all trades, pre-coordinating their layouts and shop drawings with each other, including the Electric Contractor.
3. The HVAC Contractor shall prepare drawings in ACAD Release 2014 or newer edition. All ACAD files shall be saved suitable for release 2014. He shall be

responsible for the base drawings to be used by all other Contractors. Base drawings shall include architectural, structural and reflected ceiling plan information.

4. The HVAC Contractor shall prepare ductwork drawings, at a minimum scale of 1/4" = 1'-0", in ACAD Release 2014 or newer edition. After he has finished CD with base drawing and ductwork, it shall be circulated in the following order:

    a. Plumbing Contractor
    b. Piping Contractor
    c. Electrical Contractor
    d. General Contractor

5. Each Contractor shall use the CD for preparation of their installation drawings.
6. After all trades have completed the coordination process, the General Contractor shall hold a coordination meeting to resolve conflicts. Each Contractor shall have available a drawing of his layout to be used with a light table for overlaying purposes. A representative of each Contractor, the Architect and the Engineer shall attend. All conflicts shall be resolved at the coordination meeting. The Architect and Engineer shall resolve all major conflicts as to the degree each Contractor shall alter their layout in order to allow for sufficient space for installation of the work.
7. After all work is coordinated and all conflicts resolved, each contractor shall update coordination documents in order to reflect all required minor and major modifications.
8. When all coordination is complete, the HVAC Contractor shall distribute two (2) sets of prints of the revised coordination drawings to each of the trades involved in the project, one (1) set for the Owner's Representative and one (1) set for as-built drawings.

C. HVAC Contractor:

1. All horizontal ducts shall be located and dimensioned from column center lines. Each duct shall be drawn to scale with width, depth and bottom of duct elevation clearly noted.
2. All vertical ducts shall be located from column center lines in two (2) directions. When concealed in a shaft, each vertical duct shall be shown in its total length.
3. Terminal units, heating coils, fire dampers, grilles and diffusers shall be located and dimensioned. Terminal units shall be located so as to be readily accessible from removable ceiling panel or access panel. All necessary clearances, required by codes, shall be maintained.

D. Electrical Contractor:

1. Conduits less than 1" in size are not required to be indicated on coordination drawings; however, the Electrical Contractor is responsible for routing these conduits in a manner to not cause a conflict with other trades. Conduits not indicated on coordination drawings shall be field offset to avoid all conflicts.

F. General Contractor:

1. All furrings and holes shall be clearly noted.
2. All ceiling heights shall be clearly noted.

G. Service Areas:

1. Contractors shall indicate service areas for all equipment, terminal units, etc. by shaded areas on drawings.

PART 2 - NOT APPLICABLE

PART 3 – EXECUTION

3.1 EXISTING WORK

A. Each Contractor shall locate existing site utilities, installed in previous phase, prior to beginning work. Provide adequate means of protection during work operations. Repair existing utilities damaged during work operations to the satisfaction of the utility owner and at Contractor's expense.

B. Should uncharted or incorrectly charted piping or other utilities be encountered during work operations, notify the Engineer immediately for procedure directions. Cooperate with utility companies in maintaining active services and facilities in operation.

3.2 OPENING LOCATIONS AND CUTTING

A. Each Contractor shall give the General Contractor locations and sizes of all openings required for the installation of new mechanical work before new walls, etc. are started.

B. All cutting through poured concrete slabs and walls shall be done with core drills. No jack hammers will be allowed. All cutting and patching by General Contractor that is coordinated by the Electric Contractor. All cutting and patching not coordinated by the Electric Contractor with the General Contractor shall be by the Electric Contractor.

3.3 CLEANING AND PAINTING

A. All equipment shall be kept dry and clean during the construction period.

B. Prime and paint by General Contractor, unless otherwise noted.

C. When all work is completed and all work has been satisfactorily tested and accepted by the Architect, mechanical equipment and other exposed surfaces shall be thoroughly cleaned.

D. Repair marred and damaged factory painted finish with materials and procedures to match original factory finish.

3.4 EXCAVATION AND BACKFILL

A. Provide all excavation and backfill necessary to get the work in place. Compaction and backfill materials are to be provided by this Contractor. Work to follow Division 31, Earthwork or Section 260400.

3.5 CONCRETE WORK

A. Each Contractor shall provide concrete pads required for equipment they have supplied. See Division 3 - Cast-in-Place Concrete or Section 260400.

3.6 PROTECTION AND DAMAGE

A. In addition to the provisions and stipulation of the General Conditions, each contractor and subcontractor shall provide various types of protection as follows:

1. Protect finished floors from chips and cutting oil by the use of metal drip receiving pan and oil proof floor cover.
2. Protect equipment and finished surfaces from welding and cutting splatters with baffles and splatter blankets.
3. Protect equipment and finished surfaces from paint droppings, insulation adhesive and sizing droppings, etc. by use of drop cloths.

B. All equipment shall be stored at the site with openings, bearings, etc., covered to exclude dust and moisture. All stock piled pipe shall be placed on dunnage and protected from weather and from entry of foreign material.

C. Conduit and construction openings and excavations required for Electrical work shall be covered when work is not in progress as follows:

1. Cap pipe openings with fittings or plugs.
2. Cover wall and ceiling openings with plywood, or canvas covered framing.
3. Cover floor openings and excavations with structural material of adequate strength to support traffic.

D. The Owner’s property and the property of other Contractors shall be scrupulously respected at all times (including damage from leaks). Provide drop cloths and visqueen or similar barriers where dust and debris is generated, to protect adjacent area.

E. Contractor shall be held responsible for damage caused by his work or through neglect of his workmen. Repairing of damaged work shall be done by Contractor as directed by the Architect. Cost of repairs shall be paid by Contractor.

F. The Owner reserves the right to make emergency repairs as required to keep equipment in operation without voiding the Contractor’s guarantee bond not relieving the contractor of his responsibilities during the bonding period.

3.7 SPECIAL ATTENTION

A. After all dust making procedures are performed and finishes cured, Electric Contractor shall start all air handling units in order to purge the building. Electric Contractor shall adequately protect each intake of air handling unit with disposable filter media to prevent damage to unit. Electric Contractor shall perform service maintenance; thoroughly clean all units including coils, and replace filters on all air handling units before the Owner occupies the space and at no additional cost to the Owner.

END OF SECTION 260000

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SECTION 260400 – GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL

A. The following paragraphs are applicable to Division 26 and are complementary to other sections of specifications. Where items described in other sections of the specifications are repeated herein, it is done to call special attention to or to qualify them, but it is not intended that any part of the documents shall be assumed to be omitted if not repeated herein.

B. Where contradictions occur between this section and Division 1, the most stringent of the two shall apply. Architect/Engineer shall decide which is most stringent.

1.2 DRAWINGS AND SPECIFICATIONS

A. Electrical drawings are diagrammatic and indicate general arrangement of systems and work included in the contract and shall be adhered to insofar as possible. The drawings and specifications are complementary and are intended, without giving every minute detail, to cover a workable installation complete in every respect including, whether mentioned or not, all material and equipment usually furnished with such systems and/or needed to make a complete operational installation omitting only such parts as are specifically excepted.

B. Consult drawings and details for exact location of fixtures and equipment, and where not definitely indicated, request this information in writing.

C. The specification for this division of the work is written in sectional form for brevity and convenience in reference, without repeating in each section all applicable general clauses and/or pertinent data covered elsewhere in the specification, but it is not intended that any of the documents shall be assumed to be omitted if not repeated in this division.

D. Where specifications are written for brevity, with incomplete sentences, the omission of words or phrases, such as "this contractor shall", "shall be", "provide", "furnish", "all", etc. are intentional and such omitted words or phrases shall be supplied by inference; unless otherwise mentioned, such clauses, lists, and/or directives indicate work to be done by this contractor for that specific branch of work.

1.3 EXISTING WORK AND/OR VERIFYING CONDITIONS

A. The work under this contract occurs on the site of and within the existing facility. The Owner will continue to use the present building during the construction period. The work under this contract shall be scheduled and performed so as to provide a minimum of interference with the normal operation of the existing building.

B. Before submitting a proposal, Electrical Contractors shall visit the site, and shall also carefully examine all bidding documents including those for other branches of the work, to satisfy themselves as to the nature and scope of all work to be done. Prints showing the original

building architectural, structural, mechanical, and electrical work are available at the Engineer's office for contractors' review

C. The submission of a proposal shall be taken as evidence that such an examination has been made and difficulties, if any, noted. Later claims for labor, work, material, and equipment required for any difficulties encountered which could have been foreseen, shall not be recognized, and all such difficulties shall be properly taken care of by this contractor at no additional expense to the Owner.

D. The accompanying drawings and specifications illustrate and describe the existing conditions, mechanical and electrical utilities, sewers, water mains, pipes, ducts, conduits, etc. that are particularly relevant to the new work insofar as these mains are shown on existing records or evident by field inspections and tests; however, it is not the intent that these documents shall be construed to guarantee to the contractor the exact location of these items. The contractor shall verify and determine the exact location of these items in the field, and all work under this contract shall be executed to avoid conflict with or damage to existing work. The work shall be planned and executed to avoid interference, as much as possible, with the normal use of the existing building.

E. All work involving hazards to persons shall be suitably barricaded and provided with warning lights or signs, as required.

F. Where necessary for the performance of the contract, existing work shall be cut, altered, removed, or temporarily removed and replaced. Work that is altered or replaced shall match similar existing work and said work shall be performed by trade applicable to the work; if said work is NOT shown or noted the Drawings relating to applicable trade, cost shall be paid by contractor requiring said work. However, unless otherwise provided by the drawings or specifications, no structural members shall be cut or altered without authorization of the Architect and Engineer. Work remaining in place, which is damaged or defaced by reason of work done under this contract, shall be restored in kind equal to its condition at the time of award of the contract by applicable trade as hereinbefore specified.

G. Existing work shall not be disturbed further than necessary for proper installation of new work. New work to be connected or made integral with existing work shall be properly erected to secure solidity and be continuous in finish. Such new work in extension of existing work shall correspond in all respects with that to which it connects, or similar existing sound work, unless otherwise specified.

1.4 ALTERATIONS TO EXISTING WORK

A. Alterations and additions to existing work shall include the requisite dismantling of the old equipment, rigging, wrecking, hauling, protection of permanent equipment and the building structures, and cleaning up. Care shall be exercised to keep dust and dirt to a minimum and to confine it to the area where the removal work is being performed. All debris shall be promptly removed.

B. If asbestos insulation is encountered on any existing wiring which is to be removed or remodeled, contractor shall immediately notify Owner of the existence of asbestos and Owner will arrange proper removal of same without cost to contractor.

C. Unless otherwise noted, remove all other existing equipment and conduit, wires, boxes, etc. which will not be reused in the final arrangement. Unless otherwise noted, all items which will

be removed by this contractor and not reused shall become the property of the contractor and shall be promptly removed from the site by him.

1.5 EXISTING MECHANICAL AND/OR ELECTRICAL FACILITIES

A. Where existing mechanical and electrical facilities and/or service lines occur in the area of the work and such facilities or lines are to be abandoned or changed, the contractor for the branch of work or trade involved shall cut off and properly cap the old lines, so as not to interfere with the new construction work. If any portions of such lines are required for the operation of the existing building the lines shall be altered and relocated to clear new construction and shall also be restored into service to provide continued operation of the existing building.

1.6 INTERRUPTION OF SERVICES

A. The existing facility will be occupied and will remain in operation throughout the period that this work is being performed, and certain new work will be performed during this period. Unscheduled interruptions of the facility will not be tolerated. The contractor shall exercise extreme caution, shall thoroughly inform his workmen and subcontractors of the critical nature of this work, and shall continually review the work procedure being followed in order to prevent accidental interruption of service. Before performing any act which could result in interruption of service, the contractor shall notify the Owner and Engineer of the hazards involved and the contractor shall proceed in a manner and at a time specifically approved by the Owner and Engineer.

B. All work necessitating the temporary turning off or shutting down the operation of existing mechanical and/or electrical facilities shall be done at times specifically approved by the Owner in advance of any disruption of existing facilities.

1.7 MATERIALS AND EQUIPMENT

A. All materials and equipment entering into the work shall be approved by the Architect and Engineer, and must be new, without defects, and of the sizes and capacities shown on the drawings or hereinafter specified. All manufactured materials or equipment shall bear the identification mark of the manufacturer or, if required by the Architect and Engineer, shall be certified by an approved testing laboratory. All equipment shall operate within the manufacturer's range of speeds, guaranteed capacities, performance, etc. as indicated by the manufacturer's latest catalog and/or engineering data, shall be of proper size and dimension for the allocated space, and shall be placed in the space allocated in the proper construction sequence. Special consideration will be given to equipment which has been in successful field use or similar applications for at least three (3) years (exclusive of field tests), and to equipment which has an extended guarantee period in lieu of long use period. This contractor shall submit with his bid complete data on equipment he proposes to use; failure to so submit, or to meet these requirements fully and those of the specifications, shall be grounds for rejecting the items.

B. All electrical materials, apparatus, and equipment shall be new, of the make and characteristics specified, shall conform to NEMA standards, and shall be designed to comply with and be installed in accordance with the latest rules and regulations of the National Electrical Code, and all of the legally constituted public authorities having local jurisdiction. Upon completion of the work, furnish a certificate of approved inspection from an approved electrical insurance inspector. Verify the exact voltage and current characteristics at the building before ordering motors or similar equipment.

C. Conduct such tests and adjustment of equipment as specified or necessary to verify performance requirements. Submit data taken during such tests.

1.8 QUIET OPERATION

A. The work shall be installed in such a manner that under all conditions of load it shall operate without sound or vibration which is objectionable in the occupied spaces, in the opinion of the Architect and Engineer.

B. In case of moving machinery, sound or vibration noticeable outside of the room in which it is installed or annoyingly noticeable inside its own room will be considered objectionable. Sound or vibration considered objectionable shall be corrected by the contractor.

1.9 PROTECTION

A. In performing this contract, safeguard workmen and the public and protect the work and equipment until final completion and acceptance. After delivery and before and after installation, protect work against theft, injury, or damage. Carefully store material and equipment received on site which are not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing materials. Protect related or adjacent work and the material of the other trades or the Owner from damage that might be caused by this work and make good any damage thus caused. Provide all safeguards, scaffolding, drop cloths, etc. as required.

B. No welding or soldering shall be done near combustible materials of any kind; all adjoining work, finished surfaces, glass, etc. shall be protected from flames, sparks, hot metal, etc. by metal guards or approved noncombustible drop cloths or barriers.

C. Each contractor shall replace any items or portions thereof wherever removed or damaged, in a manner equal to the original construction and finish, or where directed by the Architect and Engineer, contractor shall pay other trades to perform this work.

D. All mechanical and electrical equipment with a factory finish shall be protected during construction and must be free of dust, dirt, cement splatters, etc. when building is turned over to the Owner. Dents and marred finishes are to be repaired to the satisfaction of the Architect and Engineer, or a replacement furnished where necessary.

1.10 EXECUTION OF WORK

A. Promptly upon award of contracts, the Electrical subcontractor shall confer with the General Contractor and Engineer and the other subcontractors to prepare a time schedule for completion of the work. The electrical work shall be performed and coordinated with the program of the General Contractor and the other subcontractors. Each subcontractor shall proceed diligently with the work and shall cooperate with the General Contractor and the other subcontractors to maintain the approved project construction and progress schedule to the best of his ability and as conditions permit.

1.11 GENERAL SUPERVISION AND INSTALLATION OF WORK

A. Each contractor shall at all times give the work his best skill and attention, including adequate construction supervision over his work, employees, and sub-contractors, and he shall fully cooperate with and confer with the Architect and Engineer and other contractors so that the best possible installation shall be obtained. Exact locations and relations are to be determined in the field, subject to the approval of the Architect and Engineer, and with preference to the dimensioned drawings and approved shop and setting drawings.

B. Unless otherwise shown, conduits, etc. shall be exposed.

C. Install conduits, etc. in a neat and workmanlike manner, close to walls, generally as high as possible, true and square to the building, utilizing standard practices, and properly graded for correct functioning of the system involved; multiple lines in close proximity shall be coordinated and neatly grouped. Install work in proper construction sequence and arranged so as to be readily accessible for operation, maintenance, and repair; minor deviations from drawings may be made to accomplish this, but changes of magnitude or which involve extra cost shall not be made without approval. All fixtures, outlets, etc. shall truly center with the adjacent architectural finish. All work, both exposed and concealed, shall meet the approval of the Architect and Engineer regarding neatness of appearance, location, and practicability of installation. The Architect and Engineer reserve the right to direct the removal and replacement of any item which, in his opinion, does not present an orderly and reasonably neat and workmanlike appearance.

D. Each contractor shall cooperate with the General Contractor in the preparation of the “Coordination Drawings”. The contractor shall familiarize himself with the work of the other contractors, shall lay out his work to meet conditions at the building, shall give freedom to and prevent conflict with the work of other contractors, and shall make reasonable modification in locations or arrangement from those indicated on the drawings if required to avoid conflicts or to conform to tile, wood, marble, or other architectural finish. From time to time as the work progresses, each contractor shall examine the work installed by others, insofar as it may affect his work, and he shall, before proceeding with the work, notify the Architect and Engineer in writing, and shall not proceed until directed by the Architect and Engineer, if any condition exists which prevents the successful installation of his own work.

E. If the contractor places any work in violation of any of the above mentioned requirements, and conflicting or unworkmanlike conditions result, he shall, without additional charge, remove and reinstall or satisfactorily readjust such portions of his work as may be necessary and as the Architect and Engineer may direct. The Architect’s and Engineer's decision regarding such conditions shall be final.

1.12 ENGINEER’S OBSERVATION

A. Periodic observation of the work by the Engineer is only for the express purpose of verifying compliance by the contractor with the contract documents to the best of his knowledge. Such engineering observations and services rendered by the Engineer or his representatives shall not be construed as the supervising of construction; nor the assuming by the Engineer of the duties and responsibility of the contractors; nor making the Engineer responsible for providing a safe place or procedure for the performance of the work or for the contractors’ employees or for sub-contractors.

1.13 EXCAVATION AND BACKFILLING OF TRENCHES, ETC.

A. Unless otherwise specified, each Electrical Contractor shall do all excavation of trenches for conduits, etc. in connection with his work, and after his work is in place and inspected by the Architect and Engineer and Civil Authorities, he shall backfill in layers of not to exceed six inches (6") in depth, thoroughly moistened, thoroughly rammed, tamped, and compacted to a density at least equal to the surrounding earth to minimize after settlement. If, in the opinion of the Architect or Engineer, the excavated material is unsuitable for backfilling, the contractor shall backfill with bank run gravel well compacted. Top of backfill or trench surface shall be level with adjoining ground or surface; furnish additional material if required to fill trenches. All surplus earth shall be moved by this contractor and disposed of as directed by the Architect or Engineer. Compact backfill in trenches within building lines the same as specified in architectural branches.

B. Any sheet piling or shoring or pumping necessary shall be done by this contractor at his own expense and all trenches shall be dug in a careful manner, with bottoms properly pitched to insure perfect drainage and to provide uniform bearing and support for each section of pipe on undisturbed soil along its entire length, except where it is necessary for the proper sealing of joints. These trenches shall be not less than 12" wider, nor more than 16" wider, than the outside diameter of the pipe or conduit to be laid therein; this requirement applies to the width at and below the level of the top of the pipe or conduit; the width above that level may be wider for proper sheeting and bracing and the proper installation of the work. Shoring, bracing, barricades, etc. shall be provided to protect the workmen and/or public amply.

C. Unless otherwise approved, the following minimum cover shall be provided above the top of underground pipes outside the buildings: Water lines, 4'-0"; gas lines, 3'-0"; electrical and telephone lines, 2'-0" above concrete encasement; sewers, refer to elevations on plans.

D. Whenever wet or otherwise unstable soil, that is incapable of properly supporting the pipe as determined by the Architect or Engineer, is encountered in the trench bottom, such soil shall be removed to a depth required and for the length designated by the Architect or Engineer, and the trench backfilled to trench bottom grade with coarse sand, fine gravel, or other suitable materials, properly compacted.

E. Excavation near or under building footings shall be backfilled with concrete installed under the direction of the Architect or Engineer.

F. Where contractor elects to have any excavation work performed by a subcontractor, subcontractor must be approved by the Owner prior to commencing any work.

G. Construction Fence
1. Refer to Division 1.

1.14 RESTORATION OF SURFACES AND CONCRETE WORK

A. Unless otherwise specified, all new concrete work for parking lots, driveways, pads, etc. shall be provided by the General Contractor. All surfaces such as concrete floors, walls, paving, sidewalks, roof deck, or other surfaces disturbed in the execution of work by this subcontractor, and which remain in use, shall be restored in kind by this subcontractor, or he shall pay the cost of such work.

B. Where each contractor has performed excavation work, each contractor shall backfill as hereinbefore specified in Paragraph 13.

C. In Landscaped Areas, such as grass or plantings, the final 6" of backfilling, grading, seeding, mulching, and planting shall be performed by a qualified, competent Landscaping Contractor. The Contractor shall include in his bid the cost of such landscaping services and shall warrant same as described under Paragraph 24.
   1. This final 6" of backfill provided by the approved Landscaping Contractor shall consist of top soil complying with Ohio DOT 653.02; ph 6.0 to 7.0 or adjusted within these limits, raked to a uniform fineness and free of rock or stones 1" or greater in any dimension.
   2. Where grass has been disturbed, the Landscape Contractor shall apply 8/32/16 organic fertilizer at rate of 1 lb. per 5 square yards and seed with 90-95% pure, 85% (minimum) germination seed of a mixture of 20% Rye grass, 40% creeping red fescue, and 40% Kentucky blue grass at a rate of 7 lbs. per 1000 square feet. Cover seeded areas with clean, weed free straw.
   3. If shrubbery and plantings must be disturbed, the Landscaping Contractor shall either remove, maintain, and reinstall said plantings or the Landscape Contractor shall furnish healthy new shrubbery and plantings similar in kind to that which was removed. In either case, the Landscape Contractor shall fertilize and provide mulch around said plants.

D. In Blacktop Paved Areas, the work shall be performed by a qualified, competent Blacktop Contractor; bids shall be based on and work shall comply with the following:
   1. All materials and workmanship shall comply with the latest edition of the State of Ohio Department of Transportation Construction and Material Specification.
   2. Paved areas shall match existing slopes and shall be without dips or low spots. All seams in paving to be flush and tight.
   3. Begin rolling when mixture will bear roller weight without excessive displacement. Repair surface defects with hot material as rolling progresses. Cut out and patch defective areas and roll to blend with adjacent satisfactory paving. Continue rolling until maximum density is attained and roller marks eliminated.
   4. Protect newly placed material from traffic until mixture has cooled and attained its maximum degree of hardness.
   5. Remove and replace mixtures that become contaminated with foreign materials and defective areas and fill with fresh, hot mix properly compacted. Remove deficient areas for full depth of course. Cut sides perpendicular and parallel to direction of traffic with edges vertical. Apply tack coat before placing new mixture.
   6. Thickness of Paving shall be as follows:
      a. Base: ODOT-301, compacted thickness 9".
      b. Prime Coat (over base): ODOT-408, 3.0 Gallons/Square Yard.
      c. Wearing Course: ODOT-404, two separate 1-1/2" layers each compacted; total compacted thickness 3".
      d. Tack-coat: ODOT-407, 0.20 Gallons/Square Yard.
      e. Restore all parking space lines and space numbers using materials in accordance with Ohio Department of Transportation Section 621 - Pavement Marking.

E. Concrete Work, shall be performed by a qualified, competent, Concrete Contractor, and work shall comply with the following:
   1. Sidewalks shall be concrete, Class C, unreinforced, complying with ODOT 608. Width and finish shall match existing adjacent sidewalks. Sidewalks shall be the same depth as the existing adjacent sidewalks or 7" deep whichever is greater.
   2. All other concrete for parking lots, driveways, and pads shall be 4000 PSI compressive strength concrete with reinforcing steel. Thickness of concrete for parking lots and driveways shall be not less than 7" thick. Reinforcing steel shall be 6" x 6" 58 pound welded wire fabric (WWF) top and bottom. All welded wire fabric shall be in flat sheets, not rolls.

1.15 SLEEVES, CUTTING, PATCHING, CLEANING, WATERPROOFING, ETC.

A. Provide and accurately set frames and Schedule 40 steel pipe sleeves for required openings in new work to minimize cutting. Perform all cutting, patching, etc. required to install the work. Use approved power operated boring machine for small holes wherever practical. Remove all rubbish incidental to the work. Where any work pierces waterproofing, provide all necessary sleeves, caulking, and flashing required to make openings absolutely watertight.

B. Refer to the ACI Code 381.71, Section 6.3 for limitations and requirements for penetrations and openings.

1.16 PATENTS

A. The contractor shall defend and guarantee the Owner against any expense, claims, litigation, etc. occasioned by the use in this work of any materials, devices, etc. covered by patents not owned by this contractor, or of which he is not a licensed user.

1.17 CONTEMPLATED WORK

A. The drawings and specifications for the mechanical and electrical portion of this project have been prepared by Motz Consulting Engineers, Inc., doing business as Motz Engineering.

B. The various items of work necessary for completion of this work are hereinafter specified under the respective section headings or shown on accompanying drawings, and shall be included in any contract or contracts made for completion of respective divisions of the work. Such contracts shall also include necessary details reasonably incidental to the proper execution and completion of such work.

1.18 MOVING MATERIALS

A. If it becomes necessary at any time during the progress of this work to move materials which have been temporarily located and which are to enter into the final construction, the contractor furnishing said materials shall, when so directed by the Engineer, move them or cause them to be moved. Cost of such moving shall be included in the contract price.

1.19 ACCIDENT PREVENTION

A. Precaution shall be exercised at all times for the protection of persons and property. The safety provisions of applicable law, building, and construction codes shall be observed. Machinery, equipment, and other hazards shall be guarded in accordance with safety provisions of the "Manual of Accident Prevention in Construction" published by Associated General Contractors of America to the extent that such provisions are not inconsistent with applicable law or regulations.

1.20 TOOLS AND MATERIALS

A. Tools and materials shall be stored on the premises at locations designated by the Owner.

1.21 PROPERTY PROTECTION

A. All hoisting shall be done with proper tag lines and buffers to prevent damage to the sides of the building. Where it is necessary to hoist materials to the roof, the parapets at top of the building and the roof where materials are landed from hoists shall be protected with heavy wood covers. Parapet protection shall be placed on both sides and top, and shall extend far enough on either side of landing point to insure adequate cover. The roof, from the landing point at parapet to final location of material, shall be adequately protected by planks laid side by side on roofing and spiked together on outside edges with planks running at right angles to main planking. The roof shall be adequately protected against leaks at all times.

B. Where hoists are erected on the roof for hoisting material up the side of the building, the roof shall be adequately protected against abrasion or other damage. Materials stored on the roof shall be placed on planks or other protection approved by the Engineer and shall be placed only at locations approved by the Engineer.

C. If hoisted materials are taken through windows, the jams, head, and sill shall be adequately protected with wood planking or proper buffers.

D. Any work, equipment, or property damaged during construction of this project and due to operations under this contract shall be repaired or replaced by this contractor, without additional cost to the Owner. Upon completion of the work, the contractor shall remove all protections herein specified.

1.22 REMOVAL OF RUBBISH

A. It shall be each contractor's duty to keep the building and surrounding premises clean, free from rubbish of every description. No rubbish, crating materials, packing, or dirt shall be allowed to accumulate at any time, but shall be removed at once and hauled away.

B. Each trade shall be responsible for its own tools and materials during the periods of rubbish removal but contractors shall use reasonable care in removal of rubbish to protect the tools and materials of others against loss or damage. The Owner reserves the right, in the event that removal of rubbish is not promptly and properly carried out by the Contractors to have rubbish removed and to charge the cost of its removal to the contractor.

C. Also, refer to Division 1.

1.23 MATERIAL SAFETY DATA SHEETS (MSDS)

A. The contractor shall obtain and maintain on-site during the course of the project the Material Safety Data Sheets (MSDS's) for all chemicals or products containing chemicals that may be considered toxic or hazardous. The MSDS's are to be forwarded to the Office of Environmental Health and Safety upon completion of the project.

1.24 INSTRUCTION OF PERSONNEL

A. The Electrical Subcontractor shall provide free on site instruction in the proper use of installed equipment to designated representatives of the Owner, sufficient to ensure safe, secure, efficient, non-failing utilization, and operation of systems. This instruction shall include the following:

1. One Site Training: Provide a minimum of 24 hours of training for owner's staff. Submit a syllabus to the Engineer prior to the first session.
2. Support: Provide a minimum of 16 hours of support either on site or by telephone to answer operations questions.

PART 2 – (NOT USED)

PART 3 – (NOT USED)

END OF SECTION 260400

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SECTION 260500 GENERAL ELECTRICAL PROVISIONS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements, Division 1 Specifications, apply to this Section.

1.2 REFERENCE TO CONDITIONS OF THE CONTRACT

A. The Conditions of the Contract General, Supplementary and other Conditions and Divisions 1 through 31 and General Requirements, apply to the work specified in Division “26” and “28”. Unless the specifications contain statements which are more definitive or more restrictive than those contained in the Conditions of the Contract, the specifications shall not be interpreted as waiving or overruling any requirements expressed in the Conditions of the Contract.

B. No claim or additional compensation shall be entertained on behalf of or paid on account of failure to be informed of the above conditions and requirements.

C. Should a bidder find discrepancies in or omissions from the drawings or specifications, or should he be in doubt as to their meaning, he should at once notify the Associate who shall send written instructions to bidders. If these are ignored by the Contractor, he shall be responsible for furnishing the proper or workable equipment as necessary.

D. Before submitting a bid, bidders shall be held responsible to have visited the site of work, attend the Pre-Bid Meeting, and fully inform themselves as to existing conditions and limitations, including rules, rates and fringe benefits, travel pay, affiliation fees and transportation expense prevailing in the local labor market, and no allowance shall subsequently be made on behalf of the bidder by reason of any error on his part.

E. Carefully examine the architectural, structural, heating, ventilating and air conditioning, plumbing and any other relevant contract documents. If any discrepancies occur within Contract documents, report such discrepancies to the Associate in writing and obtain written instructions as to the manner in which to proceed. No departures from the contract documents shall be made without prior written approval of the Associate.

F. Obtain any additional reference documents and/or information required for installation prior to installing equipment. Coordinate work with other trades making minor adjustments as required. Wiring or conduit layouts are schematic based and exact locations shall be determined by structural or other restricting conditions.

G. Minor details not usually shown or specified but necessary for proper installation and operation shall be provided in the Electrical Contractors estimate, the same as if herein specified or otherwise shown.

H. Coordination with the Utility servicing this facility including following and policies of the utility company shall be included in this bid. Where material and installation is deemed the responsibility of the Electrical Contractor by the Utility Company, such work shall be included within his bid.

I. Electrical Contractor bid submission shall give written notice to the Architect of record any materials or apparatus believed inadequate, in violation of laws, ordinances, rules, standard installation practices and any necessary item required or work omitted. In the absence of such written notice, it is mutually agreed that the Electrical Contractor has included the cost associated of all required item in his proposal and that he will be responsible for the approved

satisfactory functioning of the entire system without extra cost compensation.

1.3 WORK INCLUDED

A. Provide and install a complete and operating electrical installation in accordance with these specifications and accompanying contract documents. This shall include required labor, material, apparatus and supervision.

B. Without limiting or restricting the volume of work and solely for convenience, the work to be performed will, in general, comprise the following:

1. Demolition of selected electric feeders, branch circuits and supporting equipment. Coordination of demolition work with other trades.

2. Provide new feeder and branch circuit wiring including overload and disconnecting means. Alterations to existing wiring systems per plans.

3. Provide wiring devices, covers, multi-gang plates and supporting back boxes and/or equipment.

4. Provide emergency lighting systems, with battery back-up and related equipment. Provide light fixtures, retrofits, new lamps, supports, controls, wiring and related branch circuits.

5. Support and provide wiring of equipment and final connections of equipment furnished by others.

6. Grounding and bonding of equipment.

7. Modifications to or replacement of existing systems such as; Fire alarm, telephone, public address and security systems.

8. Coordination, handling, installation and test of Owner furnished equipment or materials.

9. Required material and labor necessary to complete project scope as indicated within project Contract documents.

10. Temporary services: construction lighting and power.

11. Fire alarm devices alterations including new device installation such as detectors, door holds, notification appliances, activation appliances, field information gathering, field required documentation, system programming alterations, testing, and coordination.

C. Items of labor, material, and equipment not specified in detail or shown within Contract documents, but incidental to or necessary for the complete installation and proper operation of the several branches of work and described herein, or reasonably implied in connection herewith, shall be furnished as if called for in detail by the specifications or Contract documents. This includes electrical work associated with mechanical and plumbing work whether indicated on electrical drawings or not.

D. This contractor is advised to carefully coordinate the delivery of large, awkward, heavy equipment, material or relevant items. Delivery limitations may require modifications, supporting means or structural modifications in order to set equipment or components. This contractor shall be responsible for all calculations, material, labor, equipment, machinery, deliveries, transportation or safety related equipment required for equipment such as but not limited to: transformers, switchgear, generator, site lighting, disconnects, staging materials, panelboards

etc.

E. Electrical Contractor shall provide raceways, fittings, supports, feeders, branch circuits, overload/short circuit protection, relays, starters, terminals and related accessories to complete his work including installation and termination of items, equipment or controls furnished by other contractors unless specifically stated otherwise.

F. It is the responsibility of the Electrical Contractor to verify proper motor rotation and sizing of motor overload protection is in compliance with NEC and equipment manufacturer.

1.4 WORK NOT INCLUDED

A. The following items of Electrical Construction are not included in this contract:

1. Low voltage wiring of certain systems or devices shall be done by the respective Contractor such as temperature control wiring, interlock wiring and related control devices for HVAC equipment unless noted or otherwise. Raceways shall be provided by the Electrical Contractor.
2. Certain motors and equipment shall be provided by others, complete with motor and built-in or separate controllers as covered by such contracts such as packaged HVAC or plumbing equipment. The Electrical contractor shall provide feeders, branch circuits and/or disconnecting means as called for within the Contract documents.

1.5 DEFINITIONS AND ABBREVIATIONS

A. Definitions

1. "Furnish" shall mean supply and deliver to project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.
2. "Install" shall be used to describe operations at project site including unloading, packing, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning, and similar operations, as applicable in each instance.
3. “Installer” shall mean a company or individual specializing in performing work meeting the requirements of their trade with minimum of three (3) years of experience.
4. "Provide" shall mean furnish and install, complete and ready for intended use, as applicable in each instance.
5. "Directed" shall mean as directed by Xavier University or its Representative prior to installation of equipment.
6. "Indicated" shall mean "indicated on Contract Documents".
7. "Shown" shall mean "shown on Contract Documents".
8. "Section" shall mean one of the Specification Sections.
9. "Division" shall mean one of the Specification Divisions.
10. "Article" shall mean one of the numbered paragraphs of the Specification Section. "Work" or "Electrical Work" herein includes products, labor, equipment, tools, appliances, transportation and related items, directly or indirectly required to complete the specified and/or indicated electrical installation.
11. "Code" shall mean any and all regulations and requirements of regulatory bodies, public or private, having jurisdiction over the work involved.
12. "Product" used in Division 26, 27 and 28 means material, equipment, machinery, and/or appliances directly or indirectly required to complete the specified and/or indicated Electrical Work.
13. "Standard Product" shall mean a manufactured product, illustrated and/or described in catalogs or brochures, which are in general distribution prior to the date of issue of construction documents for bidding. Products shall generally be identified by means of a specific catalog number and manufacturer's name.
14. "Wiring" shall mean fittings, conduits, wires, junction boxes, connections to equipment,

splices, and other accessories required to complete the work.

15. Abbreviations and Symbols: See lists on drawings.
16. "This Contractor" shall mean the Contractor responsible for Divisions 26, 27 and 28 work.
17. Contract Documents: drawings, specifications, manufacturer's specification/data sheets, bid forms, addendum, and change orders.
18. Whenever the phrases "approved by the Associate or Owner's Representative," "approved equivalent," or "equivalent to" appear in these specifications, they shall be interpreted as meaning "as recommended by the Associate and approved by the Authority."

B. Reference to the latest editions of codes and standards shall mean:

Reference	Definition
NEC	National Electrical Code
ASTM	American Society for Testing Materials
NEMA	National Electrical Manufacturers Association
ANSI	American National Standards Institute
FS	Federal Specification, US Government
CS	Commercial Standards issued by US Department of Commerce
NESC	National Electrical Safety Code
NETA	National Electrical Testing Association
ADA	Americans with Disabilities Act
OBC	Ohio Building Code
NFPA	National Fire Protection Association
Owner	Owner / Owner's Representative

1.6 REGULATIONS

A. Electrical work, equipment, and materials furnished and installed under this contract shall conform to the requirements of the latest edition of the National Electrical Code, the National Fire Protection Association and any other governmental or local authorities having jurisdiction. Pay any fees required for the installation of this Division work. Certificates of approval shall be obtained in duplicate from any department or agency issuing same, and shall be turned over to OWNER or its representative at the completion of the work.

B. Provide any labor, materials, services, apparatus, CAD drawings and documents required to comply with applicable laws, ordinances, rules and regulations, whether or not shown.

C. Obtain certificates of inspection and approval from authorities having jurisdiction and deliver same to OWNER as a prerequisite for final acceptance of the work. Provide record copies of permit applications, permits and other items for which certification are indicated.

1.7 SPECIAL ENGINEERING SERVICES

A. In the instance of complex or specialized electrical systems such as fire alarm, security, telecommunication or similar systems; the installation, final connections and testing of such systems shall be made under the direct supervision of qualified authorized service engineers who shall be in the employ of the respective equipment manufacturer. Provide OWNER with copies of instruction manuals and booklets for each system and piece of equipment installed. Provide any additional instructions over and above that listed above in the care, adjustment and operation of parts of the electrical systems.

B. Pay any and all expenses incurred by these equipment manufacturers' representatives.

1.8 SUBMITTALS

A. Shop drawings, product data, and samples shall be submitted to the Associate for approval. Submit a minimum of (6) sets (or equivalent documentation in PDF format) of shop drawings and related specifications to the Associate in a bound set included with letter of transmittal.

1. Electrical Contractor must first review content for project specification compliance prior to submission. Drawings and specifications shall bear the Electrical Contractor’s approval stamp indicating specification compliance. Sets received without Electrical Contractors approval stamp will not be reviewed.
2. Shop drawings shall be new drawings, and not reproductions or tracings of the Contract Documents. In preparing shop drawings, establish lines and levels for the work specified, and check the drawings to avoid interference with structural features and other work. Immediately call to the attention of the Architect any interference for clarification in writing.
3. Manufacturer's literature and data sheets shall be submitted indicating the necessary installation dimensions, weights, materials, and performance information. Each piece of literature shall be identified with the specific specification number, paragraph, and equipment schedule identification.
4. Engineer’s review of Manufacturer documents or specifications shall not relieve the contractor from responsibility of errors or omissions in such submittals, schedules, drawings or deviations form contract documents.
5. Layout and detail drawings shall be submitted in the form of legible sepia reproducible and paper prints. Manufacturer's drawings shall be standard drawings. Equipment shop drawings shall show specific data and other special features required for review consideration.
6. Equipment shop drawings (8-1/2 by 11 inch sheets) shall be bound together in sets, in loose leaf binders, and shall be indexed in accordance with Specification Section. Additional shop drawings may be submitted at a later date for insertion therein, and the original submittal shall note which shop drawings shall be submitted later. Marked-up catalogs are not acceptable, and shall be rejected.
7. Materials and equipment shop drawings shall be submitted within 30 calendar days of Contract receipt.
8. Manufacturers' instruction manuals shall be submitted together with shop drawings. Furnish instruction manuals and parts listed for each piece of electrical equipment, on 8-1/2 by 11 inch sheets, or catalogs, suitable for loose leaf side binding, packaged separately, and clearly identified. Instructions shall include information pertaining to installation, operation, and maintenance of equipment as applicable. Each piece of literature shall be clearly identified with the specific job equipment identification. Literature shall be factory printed and not reproduced copies.

9. Any characteristic of any piece of equipment which deviates from the characteristics of the equipment specified shall be hi-lighted and circled in red.

B. Submit manufacturers' data, and/or shop drawings of the following:

1. Distribution panels, branch panelboards, and related equipment.
2. Emergency and safety related equipment.
3. Transformers.
4. Lighting Fixtures with ballast data.
5. Wiring devices.
6. Automatic transfer switches.
7. Lighting controls devices such as switches, contactors, motion, occupancy sensors and relevant control sensors.
8. Surge protection and waveform corrector equipment.
9. Disconnect switches, motor starters, and controls supplied by the Electrical Contractor.

1.9 OPERATING AND MAINTENANCE INSTRUCTIONS

A. After final tests and adjustments have been completed, furnish the services of qualified personnel to fully instruct the OWNER Maintenance representative in the operation and maintenance procedures for equipment installed. Operation and maintenance instructions for major items of equipment shall be directly supervised by the equipment manufacturer's representative. Supply qualified personnel to operate equipment for sufficient length of time as required to meet governing authorities' operation and performance tests and as required to assure that OWNER representatives are properly qualified to take over operation and maintenance procedures.

1. Notify the Associate, OWNER representatives and equipment manufacturers' representatives, by letter, as to the time and date of operating and maintenance instruction periods at least one week prior to conducting same.
2. Forward to the Associate the signatures of all present for the instruction periods.

B. Furnish three (3) copies of recommended equipment operation and maintenance procedures manuals as specified herein, assembled and bound together in 8-1/2 by 11 inch three-ring binders. The ring binders shall be submitted to the Associate in accordance with procedures established for shop drawing submittals.

1. The operation and maintenance procedures manuals shall include the following:

a. Project Title
b. Associate’s Name and Address
c. Date Submitted
d. Contractor's Name and Address
e. Index (in alphabetical order, with page numbers)
f. General Description of Each System
g. Parts List, identifying the various parts of equipment for repair and replacement purposes.
h. List of spares recommended for normal service requirements.
i. Operating instructions outlining step-by-step procedures required for system start-up and operation. The instructions shall include the manufacturer's name, model number, service manual, and brief description of each piece of equipment and its basic operating features.
j. Maintenance instructions describing routine maintenance and lubrication procedures and schedules, and simplified diagrams which illustrate the systems as installed.
k. Wiring and control diagrams for each piece of equipment, showing "as installed"

conditions.

1.10 SINGULAR NUMBER

A. References made to any item in the singular number shall apply equally to as many identical items that the work may require.

1.11 PROTECTION OF SERVICES

A. Repair, replace and maintain in service any new or existing utilities, facilities or services (underground, overhead, interior or exterior) damaged, broken or otherwise rendered inoperative during the course of construction. The method used in repairing, replacing or maintaining the services shall be approved OWNER and Associate. OWNER reserves the right to make emergency repairs as required to keep equipment

in operation without voiding the Contractor's guarantee bond not relieving the contractor of his responsibilities during bond period.

B. OWNER's property and the property of other trades shall be scrupulously respected at all times include damage from leaks. This contractor shall provide drop cloths or similar barriers where dust or debris is generated protecting adjacent area.

C. This contractor shall be held responsible for damages caused by his work or through neglect of his workman or subcontractors. Repairing of damages shall be done in accordance by OWNER or its representative. Costs associated with repairs shall be paid by this contractor.

1.12 PROTECTION OF FLOORS, EQUIPMENT AND PERSONNEL

A. Protect flooring from damage during the construction period. Provide plywood or similar material under equipment or materials stored on floors, and in areas where construction may damage the floor surfaces. Replace floor surfaces (including sealer) damaged during the construction.

B. In addition to the provisions and stipulation of the General Conditions, each contractor and subcontractor of shall provide various types of protection as follows:

1. Protect finish floors from chips and cutting oil by the use of metal drip receiving pan and oil proof floor coverings.
2. Protect equipment and finish surfaces from welding and cutting splatters with baffles and splatter blankets.
3. Protect equipment and finished surfaces from paint droppings, insulation adhesives, grout, fire proofing and other related non-finished material.

C. All equipment shall be stored at the site with openings, bearings, etc., covered to exclude dust, moisture or foreign debris from entering.

D. Construction openings, trip hazards and unsafe conditions created by this contractor shall be scrupulously inspected for personnel safety and protection of property with strict compliance of OSHA work and construction practices.

E. Conduit and excavations required for electric work shall be covered when work is not in progress such as capping conduit openings, cover wall or floor openings with material of adequate strength supporting construction traffic, safety warning tape, warning lights and signs.

1.13 TEMPORARY LIGHT AND POWER SERVICES

A. Refer to the Division 1, General Requirements, of these specifications to determine

responsibility for temporary lights, power, water and heat.

B. The Electrical Contractor is responsible for all temporary power and lighting requirements throughout construction. The Electrical Contractor shall review all associated phasing plans and schedules and provide any and all equipment, either temporary or permanent, required to maintain or provide temporary power and lighting to all areas of this facility, throughout the construction process.

C. In addition to minimal temporary lighting and power needed for construction operations, occupied areas throughout construction shall be provided with temporary power and lighting services that meet or exceed the existing services that currently serve these areas. Power interruptions to such areas shall be kept minimal and be scheduled 48 hours prior to alterations of service.

D. The electrical documents indicate the final arrangement for the power/lighting/communication/ signal/data systems and do not reflect equipment, devices, etc., needed to provide the required temporary power and lighting services.

E. At the completion of this project, all temporary lighting, temporary receptacles, and temporary wiring shall be removed in their entirety.

F. Waste material generated by this contractor or relating to his work shall be properly disposed of in accordance to local, state and federal guidelines or requirements.

1.14 SUBSTITUTIONS

A. It is the intent of these specifications that wherever a manufacturer or product is specified, and the term "or approved equivalent" is used, the substituted item must conform in respects to the specified item. Consideration shall not be given to claims that the substituted item meets the performance requirements with lesser construction. Performance indicated in schedules, drawings and specifications shall be interpreted as minimum performance.

B. Note that where specific manufacturers' products are indicated in the Contract Documents, the associated systems have been designed on the basis of that product's physical characteristics. Where specific manufacturers' products are indicated in the Contract Documents and other manufacturers' names are listed, the associated systems have been designed on the basis of the first-named manufacturer's product. When products other than those used as the basis of design are provided, additional costs related installation, usage or modifications to the systems and/or structure required by the use of that product shall be paid by this contractor.

C. This Contractor shall be responsible for all costs associated with changes to sizes such as conduit, fuse, starter, wire, supports etc. caused by change of equipment from the basis of design including usage of other named manufactures. Space allocation due to usage of other manufacture shall be the responsible of the Contractor ensuring adequate clearances for maintenance, operation, service, code requirements are met.

D. Equipment of one type shall be the products of one manufacturer; similar items of the same classification shall be identical, including equipment, assemblies, parts and components.

E. Materials furnished shall be new, defect free, used in accordance to its listing and determined safe by a nationally recognized testing organization, such as Underwriters' Laboratories, Inc., or Factory Mutual Engineering Corporation, and materials shall be labeled, certified or listed by such organizations.

F. Where a specific manufacturer is specified and other manufacturers' names are listed as equivalent, the bid shall be based upon the specified or equivalent manufacturers only. Any substitutions shall be submitted to the associate no later than ten (10) days prior to the bid opening. Refer to Article I and the General Conditions of this specification for more information.

G. Final acceptance of substitutions shall be at the discretion of the associate.

1.15 PERFORMANCE OF EQUIPMENT

A. Materials, equipment and appurtenances of any kind, shown on the drawings, hereinafter specified or required for the completion of the work in accordance with the intent of these specifications, shall be completely satisfactory and acceptable in operation, performance and capacity. No approval either written or verbal of any drawings, descriptive data or samples or such material, equipment and/or appurtenance shall relieve the Contractor of his responsibility to turn over the same to OWNER in perfect working order at the completion of the work.

B. Any material, equipment or appurtenances, the operation, capacity or performance of which does not comply with the drawings and/or specification requirements or which is damaged prior to acceptance by OWNER shall be held to be defective material and shall be removed and replaced with proper and acceptable materials, equipment and/or appurtenances or put in proper and acceptable working order, satisfactory to the University, without additional cost to the Owner.

1.16 WEATHERPROOFING LOCATIONS (WP)

A. Electrical apparatus, such as outlet boxes, switches, thermal switches, manual starters, disconnect switches, combination switches and starters, motor control centers, and motor starters shall be weatherproof gasket type, NEMA Types 4 in the following instances:

1. On surface of exterior face of building, including areas where not under canopies, cast boxes with threaded hubs must be used and under canopies steel boxes with gasket connections to devices.
2. In any areas where specifically noted "WP" or required by the NEC or Electrical Regulations mentioned herein.
3. Within air conditioning enclosures.
4. In underground splice boxes.
5. On building roof.

1.17 CLEANING, PROTECTING AND ADJUSTING

A. Materials shall be stored in a manner that shall maintain an orderly, clean appearance. If stored on-site in open or unprotected areas, equipment and material shall be kept off the ground by means of pallets or racks, and covered with tarpaulins.

B. Equipment and material, if left unprotected and damaged, shall be repainted or otherwise refurbished at the discretion of the Owner. Equipment and material is subject to rejection and replacement if, in the opinion of the Associate or the manufacturer's engineering department, the equipment has deteriorated or been damaged to the extent that its immediate use or performance is questionable, or that its normal life expectancy has been curtailed.

C. During the construction period, protect ductwork, raceways, conduit and equipment from damage and dirt. Properly cap ductwork and conduit.

D. Vacuum cabinets, switch boards, distribution panels, lighting and power panels, etc., after completion of work.

E. Remove recorded construction measurements from equipment, panels, walls or other defaced surfaces.

1.18 ACCESSIBILITY

A. Coordinate to ensure the adequacy of the size of shafts and chases, and the adequacy of clearances in hung ceilings and other areas required for the proper installation of this work.

B. Locate equipment which must be serviced, operated or maintained in fully accessible positions. Equipment requiring access shall include, but is not necessarily limited to, motors, junction boxes, fire alarm devices, controllers and switchgear.

C. Provide, as required, the exact locations of access doors. Provide access doors in finished construction for installation by others. Locations of access doors in finished construction shall be submitted in sufficient time to be installed in the normal course of the work. Keep conduit and other electrical devices clear of access door openings to allow adequate space to work in or enter the concealed space.

D. Access panels shall not be smaller than 12 inches by 16 inches or as required by authority of jurisdiction and shall be all-steel construction with a No. 16 gauge wall or ceiling frame and a No. 14 gauge panel door with not less than 1/8 inch fireproofing secured to the inside of the door. Doors shall be provided with concealed hinges and be secured with suitable clips and countersunk screws. Outside of access panels shall finish flush with finished wall or ceiling surfaces. Covers shall be factory primed with two (2) coats of primer.

E. Working clearances: Provide at least 3’-0” of clear space in front of all electrical panels and as wide as the equipment with a minimum of 2’-6” wide. Height and width of working spaces shall be in accordance to Article 110.26 of National Electric Code.

1.19 GUARANTEE

A. Guarantee material, equipment and workmanship for a period of one (1) year from date of final acceptance by Associate and Owner’s Representative. Replace defective material and workmanship furnished and installed and other work and equipment damaged thereby.

B. In addition to the one (1) year guarantee, furnish any warranties or guarantees that normally come with specific pieces of equipment that exceed the one (1) year guarantee. These additional warranties shall be given to OWNER for the time period specified.

1.20 COORDINATION

A. The General Contractor shall be in charge of the coordination drawing process and shall be responsible to resolve all conflicts and settle any disputes resulting from the coordination drawing process. Coordinate and furnish in writing to other Primes, including the Associate, any information necessary to permit the work of all contractors to satisfactorily complete installation of their work with the least possible interference or delay.

B. Each Prime Contractor shall participate in the preparation of coordination drawings. No installation of permanent systems shall proceed until the coordination drawings are approved by the General Contractor. No extra charges shall be allowed for changes required to accommodate installation of system by other contractors.

C. Coordination drawings shall be prepared in Revit 2014 format for each floor level and shall be of a scale not less than 1/4 inch - 1 foot. Coordination drawings shall include equipment, lighting, telecommunication, fire alarm, cable tray and raceway plans, with elevations with dimensions. Coordination drawings shall also include required access points through ceiling panels, access

doors, cover plates, etc.

D. Field discrepancies shall be resolved by the field foreman. When discrepancies cannot be resolved, the signed-off coordination drawings shall be re-examined for rights. Any and all discrepancies in construction, phasing, etc., due to the lack of coordination shall be at the sole expense of the associated contractors and in no way will be passed on to OWNER.

E. Devices and appurtenances which are to be installed in finished areas shall be coordinated with the General Contractor and OWNER for final approval as it relates to location, finish, materials, color, and texture.

F. When work is installed without proper coordination, changes to this work deemed necessary by the Associate shall be made to correct conditions without any extra cost to OWNER.

G. Disciplines shall include in coordination: Electric, Telecommunications, HVAC, Mechanical, Plumbing, Fire Protection and Fire Alarm System.

H. Related coordination specification in Division 01.

1.21 PRE-BID SITE VISIT

A. Before submitting a bid, the Bidder is required to visit the site and fully inform themselves concerning all conditions affecting the scope of the work. Any discrepancies between the contract documents and the job site shall be brought to the Contract Officer's attention before bids are due. Failure to visit the site shall not relieve the Contractor from any responsibility in the performance of this Contract. No extra charges shall be allowed as a result of existing conditions.

1.22 DRAWINGS

A. The Electrical drawings are diagrammatic and indicate the general arrangement of fixtures, equipment, furniture and work included in this contract. Consult the project documents and details for locations and dimensions of such equipment. All dimensions shall be field verified prior to material ordering. Where such items are not dimensioned or properly detailed, contact the Architect for required information.

B. The Electrical Contractor shall follow the drawings in laying out work while checking drawings of other trades prior to installation. Maintain NEC required work clearances including overhead electric space requirements. Contact the Architect where clearances are inadequate prior to equipment installation.

C. Where directed by the Architect, the Electrical Contractor shall modify layouts as needed to prevent conflict of work with other trades. No additional charges shall be made for coordination. Failure to coordinate with other trades or within project documents shall not relieve the Electrical Contractor from his responsibility or necessity of furnishing material or performing his work as required by the contract documents.

PART 2 - PRODUCTS

2.1 MATERIALS AND WORKMANSHIP

A. Equipment shall be so built and installed as to deliver its full rated capacity at the efficiency for which it was designed. Equipment shall meet the detailed requirements indicated, and shall be suitable for the installation shown.

B. Surface mounted electrical equipment shall be installed on 3/4" thick, fire retardant mounting board. Mounting board shall bear UL classified mark indicating ASTM E 84 test compliancy. Backboard material shall have a final applied finish according to manufacturer specifications prior to mounting of electrical equipment. Finishing material may include but not limited to fire retardant coatings. Backboard material shall minimally extend 6” in all directions beyond grouping of electrical equipment. The Electrical Contractor may use discretionary expertise to provide fire retardant backboard for individual equipment such as standalone disconnect switches, starters and the like. Where said devices are grouped (starters, disconnects, contactors etc.) installation shall include fire retardant backboard. Fire retardant mounting board installed on perimeter outside walls to be shimmed 1/2" from wall with washers to permit back ventilation.

1. Approved manufacturer: Hoover Treated Wood Products Inc. - Pyro-Guard
2. Approved equal.

C. Where two or more units of the same class of equipment are furnished in same Section of Specifications, provide each from the same manufacturer. Furnish equipment and materials new and free from defects of size, make, type and quality herein specified, or as reviewed.

D. Work shall be installed in a neat and workmanlike manner. Raceway installations shall parallel exterior and interior walls and be level. Vertical runs shall be plumb.

E. Capacities, dimensions, or sizes specified or indicated are minimums, unless otherwise stated. Tolerances used in rating or testing standards specified shall not be allowed in determining capacities of equipment.

F. Materials shall be listed by the Underwriters' Laboratories, Inc. where applicable and shall be manufactured in accordance with applicable standards established by ANSI, NEMA, ASTM, and IEEE.

G. Any products judged not in accordance with the Specifications either before or after installation will be rejected. Costs associated with rejection shall be paid by this contractor.

H. Where products are specified with no reference to a particular manufacturer's product, the product used shall meet or exceed industry construction and testing procedure standards applicable to the product, for life expectancy, performance and safety.

I. Where electrical products are a fabricated assembly, the fabricator shall assume responsibility for correct operation of the entire assembly and of its individual components.

J. Tools: Provide special tools for proper operation and maintenance of the equipment.

K. It’s the responsibility of the Electrical Contractor to provide clean electrical equipment which is free from dirt, paint, blemishes or markings. Scratches to equipment or enclosures shall be touched up with factory-color paint matching field color. Acceptance to restoration shall be to the satisfaction of the Architect.

L. Required device or equipment adjustments shall be made by EC before and after equipment is in operation throughout the warranty period.

M. Job site cleanliness and site safety of the removal of electrical generated trash or debris is the responsibility of this contractor. All job site safety rules, regulations and requirements shall be followed and maintained.

2.2 IDENTIFICATION

A. Switchgear, panels, relays, terminal control cabinets, junction boxes, contactors, circuit breakers, safety switches, motor starters, and similar items shall be identified with a single nameplate. Nameplates shall be laminated phenolic with white surface and black core (red surface for emergency and white core). Use 1/16" thick material for plates up to 2" x 4" and 1/8" thick for larger sizes. The lettering shall be condensed gothic with space between the lines equal to the width of the letters.

B. Nameplate shall read as follows:

1. First line shall be 1/2 inch letters stating panel/equipment name.
2. Second line (if applicable) shall be 1/4 inch letters stating the existing panel name in parentheses ( ).
3. Third line shall be 1/4 inch letters stating voltage/phase.
4. Fourth line shall be 1/4 inch letters stating breaker number, panel number, and final room name/room number from which it is fed.
5. Fifth line shall be1/4 inch letters stating function and/or equipment which it controls.

C. Names and numbers shall coincide with those listed within Contract documents unless altered by Owner descriptors.

D. Nameplates shall be secured with screws, a minimum of one on each end.

E. Label receptacle plates with identification showing panel and breaker number from which it is fed. Labels shall be made using the Dymo RinoPro or an equivalent system.

F. Label junction boxes and pull boxes, showing circuit numbers contained in the enclosure. Use an approved marking device as noted.

G. Label wire with an identification tag showing panel and breaker number from which it is fed at splices, junctions, and terminations as explained in this specification.

H. Label fire alarm device bases with identification showing device address number assigned by fire alarm system manufacturer. Labels shall be made using the Dymo RinoPro or equivalent system.

I. Branch breakers shall be labeled by Owner provided room numbers and descriptors.

2.3 ANCHOR BOLTS

A. Provide and set in place, at the time of pouring of concrete foundations, necessary anchor bolts as required for the equipment called for under these specifications. Anchor bolts shall be of the hook type, of proper size and length to suit the equipment. Anchor bolts shall be set in pipe sleeves of approximately twice the bolt diameter and one half the embedded length of the bolt. Assume full responsibility for proper emplacement of the bolts.

2.4 INSERTS

A. Provide inserts of an approved metallic type for hangers. Where two or more parallel conduits are installed, continuous inserts may be used. Where required to distribute the load on the inserts, a piece of reinforcing steel of sufficient length shall be passed through the insert.

2.5 SLEEVES

A. Provide sleeves in all roofs, floors, and any fire-rated walls. Each sleeve shall extend through its respective floor, wall or partition and shall be cut flush with each surface unless otherwise required.

B. Sleeves in bearing and masonry walls, floors and partitions shall be standard weight steel pipe finished with smooth edges. For other than masonry partitions, through suspended ceilings, and for concealed vertical piping, sleeves shall be No. 22 USG galvanized iron.

C. Sleeves shall be properly installed and securely cemented in place.

D. Floor sleeves shall extend 1 inch above the finished floor, unless otherwise noted. Space between floor sleeves and passing conduit shall be caulked with graphite packing and waterproof caulking compound.

E. Where conduits pass through waterproofed floor or walls, design of sleeves shall be such that waterproofing can be flashed into and around the sleeves.

F. Where conduits pass through roofs, sleeves shall be installed and flashed and made watertight by the General Contractor unless otherwise specified or shown within Contract documents.

G. Sleeves through exterior walls below grade shall have the space between conduit and sleeve caulked watertight using an approved method.

2.6 FIREPROOFING

A. Where sleeves, ducts, cable trays, or other penetrations pierce floors or walls having specific fire ratings, the space between the sleeves and passing conduit shall be fireproofed with an approved UL listed fire proofing assembly. Installation method shall be per manufacturer's recommendations and approved by the Associate.

B. Reference Division 7, section “Through-Penetration Firestop System”.

2.7 WIRE GAUGE

A. The sizes of conductors and thickness of metals called for herein or within other Contract documents shall be understood to be American Wire Gauge.

2.8 MISCELLANEOUS METAL AND STRUCTURAL STEEL

A. Scope of Work: Furnish labor, materials, equipment and services necessary for the installation of miscellaneous metal and structural steel work required to complete this contract. Erect structural steel required for the proper support of equipment required under this contract.

B. Supports, brackets, and clamps and other items specified herein shall be installed in strict accordance with the best practices and recognized code.

C. Materials: Structural steel members required under this part shall conform to ASTM Standard Specification A-7. Other materials shall be as specified hereinafter.

D. Priming: steel and iron work shall be primed with Rust-Oleum 769 or approved equivalent. Before priming, metal shall be thoroughly cleaned free from scale, rust and dirt.

E. Anchors: Provide anchors, bolts, screws, dowels and connecting members, and do cutting and fitting necessary to secure the work to adjoining construction. Build in connecting members to masonry, concrete and structural steel as the work progresses.

F. Supports and Brackets: shall be neatly constructed to structural shapes to adequately support

the equipment intended. Supports must be approved prior to installation. Attention is directed to the proper rigid support required for conduit. Field conditions shall regulate the type of support required.

G. Reference Division 7, Section “Spray fire-resistive Material” for coordination of hangers an applicable supports.

2.9 VIBRATION ISOLATION MOUNTS

A. Provide vibration isolation mounts for all substations, power centers, transformers or equipment subject vibrations in accordance with this or other applicable sections.

2.10 GRADING, FERTILIZING, AND SEEDING

A. Provide labor, materials, equipment, and services required to strip and store topsoil, replace topsoil, and rough and finish grade and fertilize and seed areas disturbed beyond the work area of the General Contract. Topsoil must be stored where directed on the site.

B. Reference Division 31, “Earthwork” for backfill and compaction requirements.

2.11 MOTORS

A. Motors shall be built in accordance with the latest standards of NEMA and as specified. Motors shall be tested in accordance with ASA C50 and conform thereto with respect to insulation resistance and dielectric strength.

B. Each motor shall be provided with conduit terminal box and adequate starting and protective equipment as specified or required. The capacity shall be sufficient to operate associated driven devices under conditions of operation and load and without overload, and shall be at least the horsepower indicated or specified. Each motor type shall be premium energy efficient and of quiet operation.

C. Motor starting equipment must be selected so that starting currents or transients do not have an adverse effect on lighting or other electrical equipment. This contractor shall provide devices or equipment required to snub or eliminate such electrical disturbances.

D. Motors shall be verified for proper rotation prior to service of equipment.

E. Motors connected to inverter controllers shall comply with the requirements of Division 23 Specification 230513 “Common Motor Requirements For HVAC Equipment” when included in Contract Documents.

F. Motors shall comply with Energy Independence and Security Act of 2007.

1. Motors shall comply with NEMA MG 1 table 12-11 and 12-12 unless noted otherwise.

G. Motors connected to inverter controllers shall be inverter rated containing shaft mounted grounding protection ring such as AEGIS bearing protection ring.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide information to the General Contractor for any chases or openings required under this Contract. No cutting shall be done which may affect the building structurally or architecturally

without the prior approval of the Associate. Damaged construction shall be restored to its original conditions and finished to match the surrounding work. Refer to "Supplementary General Conditions" for the disposition of Cutting and Patching.

B. Grades, elevations, and dimensions shown on the drawings are approximately correct; however, field check and otherwise verify such data at the site before proceeding with work.

C. The Contractor shall be entirely responsible for apparatus, equipment, and appurtenances furnished by him or his subcontractors in connection with the work and special care shall be taken to protect parts thereof in such manner as may be necessary or as may be directed. Protection shall include covers, crating, sheds or other means to prevent dirt, grit, plaster or other foreign substances from entering the working parts of machinery or equipment. Special care shall be taken to keep open ends of pipes closed while in storage and during installation. Where equipment must be stored outside the building, it shall be totally covered and secured with heavy weatherproofing tarps and kept dry at all times. Where equipment has been subjected to moisture, it shall be removed from the site and replaced with new equipment. Protect open excavating until covered over.

D. Due to the schematic nature and small scale of the electrical drawings, it is not possible to indicate exact locations, offsets, fittings, access panels, pull boxes, and miscellaneous parts which may be required to form a complete system. The drawings are generally indicative of the work to be installed. Arrange work accordingly furnishing necessary parts and equipment as may be required to meet the various conditions and to provide a complete circuit from end use device to circuit protective device in panel.

E. Within thirty (30) days after acceptance of bids, submit to the Associate for approval, a complete list of equipment and materials to be furnished under this contract, giving names and addresses of manufacturers and material cut sheets they intend to furnish.

3.2 CLEARANCES

A. Take caution when routing conduit and location of equipment. In many cases, ceiling (plenums) clearance is limited due to ductwork and other mechanical lines, systems and structural steel. The Contractor shall be responsible for routing around mechanical equipment and ducts in order that everything can remain concealed in finished areas.

3.3 CUTTING AND PATCHING

A. Provide cutting and patching necessary to install the work specified herein. Patching shall match adjacent surfaces. Refer to Section 01731, Cutting and Patching, for specific direction.

B. No structural members shall be cut without prior approval of the Associate, and such cutting shall be done in a manner directed by the Associate.

C. Provide ceiling removal and replacement where work above finished ceilings is required. Replace ceiling components damaged in the process.

D. Provide patching where electrical devices are removed from or through walls, ceilings or floors.

3.4 PAINTING

A. Finished painting shall be performed by others except for standard factory finishes.

B. Electrical motor’s, pump casings, and other similar items shall be provided with three coats of machinery enamel at the factory, and shall be carefully cleaned, rubbed down, and oiled after installation.

3.5 LOCATIONS

A. Apply for detailed and specific information regarding the location of equipment as the final location may differ from that indicated on the drawings. Outlets, equipment or wiring improperly placed because of failure to obtain this information shall be relocated and re-installed without additional cost to the Owner. Determine the actual direction of door swings, so that local switches and other controls shall be installed at the lockside of doors, unless otherwise noted. Improperly located switches shall be relocated without additional cost to the Owner.

B. The design shall be subject to such revisions as may be necessary to overcome building obstructions. No changes shall be made in location of outlets or equipment without written consent of the associate.

C. Unless otherwise mentioned or indicated, mounting heights of outlets are shown on the drawings or in the specification. Dimensions given shall be considered to be from center of outlet to finished floor.

D. Coordinate the exact location and elevation of all electrical devices and fixtures with the architectural interior elevation plan and reflective ceiling plan prior to installation.

E. Properly rough in for the electrical conduit and equipment under this contract and modify as required for coordination during the construction period.

3.6 RECORD DRAWINGS

A. During the construction period, maintain in good order a complete set of as-built electrical contract drawings. Record the actual electrical installation as the work progresses. Include changes to the contract and to equipment sizes and types. Keep these drawings available at the site at all times for inspection.

B. Take proper caution against the use of superseded drawings. Check such copies and mark "void." Where drawings have been corrected by memorandum, assume the responsibility for marking all drawings so affected with the changes; such marked drawings shall remain in use until revised drawings are issued.

C. At the conclusion of the work, provide to the Associate a complete set of drawings which indicate precisely how the electrical system, single line, and riser diagram equipment has been installed. Return such reproducible drawings within 30 days to the Associate.

3.7 EQUIPMENT, FOUNDATIONS, SUPPORTS, PIERS AND ATTACHMENTS

A. Provide necessary foundations, supports, pads, bases and piers required for equipment specified in this division; submit drawings in accordance with Shop Drawing Submittal requirements prior to the purchase, fabrication or construction of same.

B. Provide concrete pads for base-mounted transformers and Electric Contractor provided rotating equipment and for other floor mounted electrical equipment. Pads shall be extended 6 inches beyond matching base in all directions with top edge chamfered. Inset 6 inch steel dowel rods into floors to anchor pads.

C. Construction of foundations, supports, pads, bases and piers, where mounted on the floor, shall be of the same materials and same quality of finish as the adjacent and surrounding floor material.

D. Equipment shall be securely attached to the building structure in an approved manner.

Attachments shall be of a strong and durable nature and any attachments that are, in the opinion of the Associate, not strong and durable shall be replaced as directed. Reference Division 3 “Concrete”.

3.8 SCAFFOLDING

A. Furnish and erect scaffolding and ladders required in the installation of wiring, raceways, cable tray, equipment and lighting fixtures.

3.9 ENVIRONMENTAL AIR PLENUMS

A. In spaces over suspended ceilings which are used for environmental air handling purposes as defined by Article 300.22C of the National Electric Code, power, data and communications cables must be in conduit or of the type cable rated for air plenum use. This Contractor shall be responsible to clearly define ceiling space used for environmental air purposes, provide material and installations meeting installation environment.

3.10 HAZARDOUS LOCATIONS

A. In hazardous locations as defined by Article 500 of the National Electrical Code, electrical work installed in these areas shall be installed in accordance with the requirements of Article 500 whether specifically called for or not. Fixtures, fittings, and devices shall be installed according to, be rated for area of installation and meet requirements of binding code, including devices, seal offs, etc. Determine such areas as defined by the NEC and NFPA and conform to requirements of the enforcing agencies.

END OF SECTION 260500

SECTION 26 05 12 - ELECTRICAL POWERED EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION

A. This section of the specifications describes the principal electrical work related to the installation, connection, and control of electrical powered equipment furnished under other divisions. Should examination of related effort indicate discrepancies or omissions, request clarification prior to bidding, performing or omitting any required work.

B. Examine Contract documents and other divisions of these specifications to ascertain the extent of powered equipment covered by the drawings and specifications and the method by which each item of equipment shall be furnished, delivered to the site, installed, and the amount of electrical work which shall be included with the powered equipment. Verify the voltage and frequency requirements of electrical equipment as it is delivered to the site. If voltage and frequency are not compatible with the building electrical system, immediately inform the Associate in writing. Particular attention is called to the following items:

1. Mechanical equipment
2. Specialized equipment
3. Owner furnished equipment

C. Definition:

1. Wiring: Contactors, conduit, enclosures, connections, labor and miscellaneous material required to supply power to powered equipment and associated controls for proper operation.

D. Motor Installation and Connections: utility motors such as fans, pumps, etc., are furnished under applicable sections of specifications. Those not provided as an integral part of the mechanical equipment, shall be delivered to this contractor at the point of installation. Receive these motors, handle, store (if required), and provide power wiring, including a phasing rotation check for applicable motors. Connect each motor to a separate branch circuit, feeder and include disconnecting means except where noted. Terminate conduit to motors in final connection with Liquidtight flexible conduit. Equipment frames shall be bonded per National Electrical Code.

E. Control Devices and Wiring: Control devices (such as pressure switches, floats, electrodes, P.E. switches, E.P. switches, relays, thermostats, etc.), prewired in packaged type equipment and/or control panels shall be provided by the appropriate contractor. Provide required interlocking control, time delay relays, control transformers, break-glass stations, remote pushbuttons required to perform functions indicated within Contract documents including requirements of local authorities.

F. Verify motor rotation for equipment before it is turned over to other Contractors or Owner.

G. Furnishing and installation of control devices, control panels, and control wiring for HVAC equipment shall be provided under Division 23.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Refer to other related sections of Division 23 for applicable materials. Particular attention is called to the following sections:

1. Section 262813, Fuses
2. Section 262913, Motor Starters

PART 3 - EXECUTION

3.1 ELECTRICAL WORK FOR MECHANICAL EQUIPMENT

A. Motors and Motor Controls: Pre-wired packaged type equipment, control devices, control panels and alarm panels for Mechanical Work, shall be furnished and installed under other sections of the specifications and wired under this section of the specifications, except as otherwise noted. Control devices which have piping connections shall be installed under other sections of the specifications. Where wall space is not available, provide suitable primed and painted angle iron framework supports for mounting of starters and controls. Power wiring shall be provided to motors, starters, variable frequency drives, consoles, and each refrigeration machine, electric boilers, and auxiliaries. Perform required adjustments, wiring modifications, in conjunction with any testing and operational system start-up procedures. In general, starters, disconnects, switches and fuses shall be furnished under Division 23 and wired under this division.

B. Responsibility: Electrical work specified in Division 23 as "by the Electrical Contractor" is an obligation of this contractor, the same as if specified herein.

1. Electric Heaters (Plumbing or HVAC): electric heaters are furnished under other Sections. Provide power wiring at heaters. Thermostats for heaters furnished under other sections.
2. Control Wiring for HVAC Systems: control wiring of HVAC equipment shall be under Division 23 unless noted otherwise.

END OF SECTION 260512

SECTION 260519 WIRES & CABLE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements, Division 1 Specifications, apply to this Section.

1.2 DESCRIPTION

A. Provide all wires and cables in accordance with the Contract Documents for service, feeders, branch circuits, lighting, systems, egress, control wiring and telecommunications.

B. This section includes cable requirements for systems below 600 volt insulation.

C. Conductors shall be soft drawn stranded copper having conductivity not less than 98 percent.

D. Aluminum conductors type XHWN #6AWG or greater are permitted only on service conductors or feeders to distribution equipment or panelboards otherwise indicated or directed within Contract Documents. Splicing of distribution or a feeder circuit is prohibited. Aluminum conductors for branch circuits which feeds lighting or receptacles is not allowed.

E. All wiring and cables shall be installed in raceway unless otherwise noted.

F. Conductors shall be insulated for minimum of 600 volts. Motor conductors (T-leads) controlled by variable frequency drives shall have a minimum rating of 1000 volts for voltages over 240v.

G. All conductors shall be U.L. labeled and installed in accordance to the NEC.

H. Insulation types are the type referenced in NEC.

PART 2 - PRODUCTS

2.1 600 VOLT WIRE OR LESS

A. Conductors shall be “UL” approved stranded copper with a minimum insulating rating of 600v.

B. Manufacturers:

1. Southwire Company
2. General Cable Corporation
3. American Insulated Wire Corporation
4. Approved Equal.

C. Type of conductor insulation for general use shall be as follows, subject to limitation listed:

1. Type THW – no restrictions
2. Type THHN/THWN – restrictions as follows:

   a. Do not use for conductors in/under slab.
   b. Do not use in wet locations.

3. Type XHHW – no restrictions.

4. Fixture wiring shall be single conductor, 600 volt, 200˚C, Type SF-2, stranded silicone rubber insulation with overall glass braid.

a. Wiring routed within ballast trough shall be high ambient wire: single conductor, 600 volt, 125˚C minimum, Type SA stranded silicone rubber insulation with overall glass braid.

5. Fire alarm cable: EC to provide all power and signal circuits for the fire alarm system. Wire and cable requirements must meet NEC and that of fire alarm system Manufacturer. Refer to Specification 28 31 00 for cable types and usage.

2.2 TYPE MC CONDUCTOR CABLE

A. MC conductor cable usage is only approved for connections to ceiling grid mounted light fixtures (from overhead powered junction boxes). MC cable shall be constructed with insulated phase(s), neutral and one full size green conductors. Branch circuit type MC cable (14-6 AWG) shall use copper conductors. All MC conductors shall be type THHN/THWN-2 600v stranded.

B. Manufacturers:

1. AFC Cable System
2. General Cable
3. Alcan Cable
4. Southwire
5. Approved equal

2.3 PLENUM CONDUCTOR CABLE

A. Plenum conductor cable may be used for NEC Class 2 or 3 wiring if conductor cable is UL listed in accordance with UL 910 and UL 1820 and is installed in accordance with the NEC and is acceptable to the Authority having jurisdiction. Insulation types, UL listing, and written acceptance by the local authority shall be submitted for review.

B. Installation of cables shall be installed in a neat and workmanship like manner. Cables shall be supported conforming to the requirements of the latest edition of National Electrical Code and Electronics Industries Association and Telecommunications Industries Association.

2.4 CONNECTORS & LUGS

A. See Specification 262730 “Taps, Splices & Terminations”

2.5 ADJUSTABLE FREQUENCY DRIVES (AFD/VFD)

A. Motor Conductors for voltages greater than 240v and length exceeding 45ft from AFD/VFD:

1. Cable characteristics:

a. As recommended by AFD manufacturer and meet minimum requirements: UL standard 44, 1277, MSHA & TC-ER approved, 600-1000 volt rated, 90˚C, XLPE insulation with copper tape shield with symmetrical grounds. Wire gage sized per NFPA 70-460.6(A).

b. Manufacturer:

1) LAPPUSA Olflex VFD Symmetrical
2) SAB Associated Wire Products (SAB North America)
3) Belden - Large VFD Symmetrical Design

4) Approved equal

2. Bending radius: Electrical Contractor shall provide means of maintaining motor conductor minimum bending radius throughout protective raceway, pull boxes and terminations.

2.6 MOTOR TERMINATIONS

A. Motor branch conductors larger than #10 AWG shall be connected to the factory motor leads with compression type connector. Field wiring and factory wiring shall be terminated with individuals crimp type, single indent terminal lugs. Crimp connections shall be sized fro the connecting wires, type and construction. Individual connections shall be joined through bolting with a combination of bolt, nut, flat and locking washer.

B. Conductive motor terminals shall be insulated and sealed with factory engineered motor connection kits. Connection kits shall be rated for voltage, insulation class and dielectric strength. Connection kits shall be rated for 90˚C continuous conductor operation. Motor connection kits shall be equal to type RVC or MCK as manufactured by Raychem Corporation or equal by 3M or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide circuit wiring complete as shown as called for within Contract documents, and as hereinafter specified or required. The minimum size of wire for branch circuits shall be No. 12, except 120 volt circuits over 100 feet in length shall be No. 10; 120 volt circuits over 150 feet in length shall be No. 8. Wiring shall be increased in size if so demanded by wattage of load.

B. Voltage drop calculations shall be performed by the electrical contractor. Conductors sized shall be increased where branch circuit calculations result in a voltage drop greater than 3%.

C. 600 volt wiring shall be color coded. Consistent phase identification of wires from service feeders to branch circuit wires shall be maintained as follows:

1. 120/208 volts - Normal - Phase A.....Black
2. 120/208 volts - Normal - Phase B.....Red
3. 120/208 volts - Normal - Phase C.....Blue
4. 120/208 volts - Neutral.....White
5. 120/208 volt - Ground Wire.....Green
6. 277/480 volt - Phase A.....Brown
7. 277/480 volt - Phase B.....Orange
8. 277/480 volt - Phase C .....Yellow
9. 277/480 volt - Neutral.....Grey

D. Fire alarm wiring or cable color coding shall be RED or per manufacturer’s recommendation.

E. Labeling: Electrical contractor shall identify each termination via a permanent printed type “Brady” wire marker as noted.

F. Do not pull wires into raceways until raceways are permanently in place, thoroughly clean, and termination points are not subject to damage. Usage of pulling lubricants shall be applied sparingly.

G. Do not use uninsulated wire conductors.

H. Provide excess free conductor end length at termination points, adequate to make up splices and terminations, permitting neatly training conductors, and in any case not less than:

1. No. 14 through 10 AWG - 8 inches
2. No. 8 or 6 AWG - 12 inches
3. Larger than No. 6 AWG - 18 inches

I. Support vertical cables as required by Code. Use lock type cable support bushings having internal wedges and retaining collars. Locate support points in readily accessible pull boxes sized to code requirements.

J. Control circuit wiring in cabinets, panels, pull boxes, etc., shall be tied, bundled and held with Thomas & Betts Nylon Self-Locking Ty-Raps, or approved equal.

K. Large equipment pull, junction or terminal boxes shall contain suitable racks to support, arrange, and retain wire and cable in an orderly manner.

L. Equipment conductors smaller than No. 4 AWG, in wireways, gutters, pull boxes, terminations, etc., shall be identified with wire markers. Designate panel and circuit number on each individual marker.

M. Feeder or equipment conductors No. 4 AWG or larger, shall be individually identified with metal, fiber or fireproof linen tags or with wrap around markers. Designate panel circuit number on each individual marker. In addition, designate use of each set of conductors on a common tag or on each individual conductor marker. Tagging shall include panel source and feeder size of equipment supply.

N. Switchboard and distribution panelboards with ratings greater than 10,000 RMS symmetrical amperes shall have supply cables braced in accordance with board manufacturer bracing requirements where such panels are approved for bracing.

1. Wrapping of cables: Wrap line cables together with nominal 3/8-inch nylon rope or rope having a minimum tensile strength of 2000 pounds at 6 inches and 12 inches from the line terminals with minimum of five non-spaced wraps.
2. For electrical equipment that is not clearly marked as to whether or not cable bracing is required, contact the Manufacturer’s representative.

O. Where the single pole work is used on branch circuits, circuit wiring shall have a dedicated neutral conductor. Do not gang or share neutrals. The Contract documents are schematic and diagrammatic and indicate the general method of installing circuit wiring and the outlets which are to be supplied.

P. Lighting and convenience outlet circuiting are indicated on the Contract documents separately as single pole work for clarity; however, the Electrical Contractor shall provide a minimum of 20 percent spare future capacity in each raceway.

Q. All branch circuits shall have a dedicated neutral conductor. Sharing neutrals is not permitted.

R. The minimum sizes of wire on an installation shall be as follows:

Emergency and Exit Circuits ..... 10 AWG

Lighting and Power Circuits ..... 12 AWG

Signal Circuits - with common or individual leads ..... 14 AWG

Remote Control Leads ..... As recommended by manufacturer

Low Voltage Light Control, Communication, ...	Twisted Pair, Shielded or as recommended by manufacturer
Data, and Fire Alarm Systems.....	Shielded or recommended by manufacturer
Fixtures	14 AWG Min. SF-2 and as required by Underwriters Laboratories and National Electrical Code

S. Install in each empty interior conduit, one nylon measuring fish line for the future installation of wire or cables.

T. Great care shall be exercised in pulling wires into the conduits so as not to injure the insulation. Only UL approved lubricants shall be used to assist in the pulling in of wires with an outer covering or braid.

U. Where switch boxes are used as the termination of the "home runs" in addition to the switch legs, not less than a two-gang box shall be used.

V. The size and general location of the various feeders or branch circuits are approximately shown. However, the electrical contractor shall determine and coordinate the exact location and routing at the site.

W. Seal around conduits penetrating fire-rated elements according to Division 7, Section "Through-Penetration Firestop Systems".

X. Communications, sound, dimming, fire alarm, data and other low voltage wiring shall be of size by the manufacturer of the equipment being served and cable type as required by the National Electrical Code.

Y. Branch circuits to be connected as numbered within Contract documents. Prior to energizing, test cable and wire for continuity of circuitry, and also for short circuits. Correct malfunctions when detected.

Z. In every pull or splice box and all other places where wires and cables may not be readily identified by nameplate on the equipment to which they connect, each circuit shall be identified with a permanent identification tag securely fastened to the conductors.

END OF SECTION 260519

SECTION 260526 GROUNDING & BONDING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION

A. Provide all system equipment and static grounding in accordance with the Contract Documents and in full compliance with the lasted edition of National Electrical Code, and the Authority having jurisdiction. Grounding requirements specified in this section may be supplemented by special requirements of systems described in other sections such as Section 27 10 00 “CABLE”.

B. Ground every device and metal part of the electrical system including all enclosures, fixtures, boxes, feeders and branch circuits over 40 volts shall include a copper grounding conductor sized in accordance with NEC Table 250.122 except not smaller than #12 for power and lighting circuits and #14 for control circuits.

1. All equipment ground conductors shall have green colored insulation.
2. Isolated ground conductors shall have green colored insulation with yellow stripe.
3. Feeders to have alternating, three (3) green and two (2) yellow bands of tape.

C. Maintain continuity of system and equipment grounds throughout the electrical installation unless specifically shown otherwise. Provide ground bushings and jumpers where normal metallic ground paths are interrupted or unreliable.

D. Grounding shall be accomplished by means required by NEC and generally outlined in the subsequent paragraphs.

E. Grounding shall be connected to the water feed service pipe such as water heater and piping systems likely to become energized. Install a separate equipment grounding conductor to each electric water heater or heat-tracing system complying with manufacturer’s installation specifications. Bond conductor to heater units, piping, connected equipment and relevant components.

F. All electrical equipment, cabinets, boxes, conduit, metal fixture poles and metal raceways shall be grounded in accordance with the NEC and as specified herein.

G. All connections to apparatus and conduits shall be made with an approved UL type of bolted or compression connector. Connectors shall be securely fastened to the equipment. All contact surfaces shall be thoroughly cleaned and bright before connections are made in order to insure a good metal-to-metal contact.

H. All underground ground cable splicing or connections shall be exothermic welded.

I. Tie all grounding systems together at their origins and as called for by the NEC or authority of jurisdiction.

J. A solid ground shall be provided for the complete conduit system, feeder neutrals, motor frameworks, transformer cases, neutral of 480 volt and 208 volt building services, heating equipment enclosures, telecommunications and other items as required.

1.3 GROUNDING SYSTEM

A. Grounding electrodes shall be installed and interconnected according to NEC Article 250.50.

1. Bond water supply piping system in accordance with NEC Article 250.52
2. Per NEC Article 250.52(A)(3), provide a concrete-encased foundation electrode and bond to other electrodes per NEC.
3. Provide building ground ring with connections to structural steel columns in accordance to NEC Article 250.52(A)(4) at locations as shown within Contract documents. Steel columns shall be connected to the grounding electrode system with bare stranded copper where shown on contract documents or required by NEC or Authority having jurisdiction. Size bonding conductor in accordance to NEC Article 250. Connections to steel columns shall be made above grade using exothermic connection within web of column.

B. Provide insulated copper grounding conductors in conduit for metal water service pipe from building's main service equipment, or grounding bus, to main metal water service entrance. Connect grounding conductors to main metal water service pipes by approved grounding connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

C. Where installed, vertical drops from the lightning protection loops shall be connected at points located on the lightning protection plan(s). Drops shall connect first to a driven ground rod outside building then to ground loop.

D. Individual grounding risers for power, data/communications, security, and fire alarm closets shall be of wire type and sized as required by manufacturer or as specified elsewhere in specifications. Telecommunication bus bar shall be provided by this contractor and installed per BiCSi and EIA/TIA standards.

E. Where any ground conductor required protection from physical damage, route conductor through a non-ferrous conduit or a steel conduit that's bonded at both ends.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Ground conductors shall be of size indicated or required by code.

B. Ground rods shall be copper-clad steel, 3/4 inch diameter and 10 feet long.

C. Connectors shall be as manufactured by Burndy, O.Z. Gedney, or Erico.

D. Exothermic welding shall be Erico, Burndy, or O.Z. Gedney.

E. Accessible connections shall be made with multiple bolt silicon bronze connectors specifically designed and approved for the connection to be made.

F. Lighting fixtures shall be grounded by the use of a manufacture-supplied ground lug or pigtail or by the use of manufacture approved ground connection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The neutral wire for the electrical system shall not be used to ground miscellaneous conduits.

B. Ground wires required by the National Electrical Code shall be installed.

C. The resistance between the grounding system and absolute earth shall not exceed values as specified and shall be measured in the presence of the Owner's representative.

D. The equipment grounding terminal bars of the normal and emergency electrical system panel boards shall be bonded together with an insulated continuous copper bonding jumper not smaller than No. 6 copper or otherwise shown within Contract documents.

E. Steel columns

F. Electrically continuous metal raceway system shall not be used as the primary grounding or bonding conductor. A separate continuous grounding conductor shall be carried throughout the raceway system.

3.2 EQUIPMENT GROUNDING

A. Conduit system shall be electrically continuous. All locknuts shall cut through enameled or painted surfaces on enclosures. Where enclosures and non-current carrying metals are isolated from the conduit system, use bonding jumpers with approved clamps. Where reducing washers are used and where concentric or eccentric knockouts are not completely removed, bonding bushings shall be required. Conduit crossing building expansion joints shall have provision for maintaining ground continuity.

B. Cable shielding, metallic conduits, wireways, cable boxes, electrical equipment housings and all noncurrent carrying metallic parts shall be grounded. Run a separate ground wire to all equipment.

C. All conduit stub-ups shall be grounded and where multiple stub-ups are made within an equipment enclosure, such as a switchboard, conduits shall be equipped with grounding bushings and bonded together and to the enclosure ground bus.

D. Provide bonding devices, fittings or jumpers at expansion fitting, isolation sections or wherever continuity of ground is broken.

E. Install all grounding conductors with sufficient slack, to avoid breaking due to settlement or movement of conductors or attached points. Installation of bonding straps or jumpers shall be provided for vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

F. Motors shall be grounded by means of a grounding conductor located in the same raceway with the motor feeder connected to a grounding bushing at the motor terminal box and the ground bus from source of power or to the incoming conduit grounding bushing of an individually mounted motor starter.

G. Where flexible medal conduit is used for all or part of a conduit run, except lighting branch circuits, a grounding conductor shall be provided in the conduit and connected to grounding bushings at each end of the run.

H. Usage of steel core Liquid-Tight conduit shall have an exterior spiral wrapped green THHN bonding conductor terminating to external type grounding fittings using a minimum green #10 copper conductor.

I. Under no circumstances shall a neutral conductor or neutral bar in an enclosure be used for grounding purposes.

3.3 FEEDER GROUNDING

A. Run a separate insulated ground for feeders.

B. Size grounds in accordance with the NEC or as noted within Contract documents whichever is more stringent.

3.4 FIELD QUALITY CONTROL

A. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.

B. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two (2) full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 8l.

C. Provide to Architect of record plan drawings locating each ground rod and 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.

1. Equipment Rated 500 kVA and Less: 10 ohms.
2. Equipment Rated 500 to 1000 kVA: 5 ohms.
3. Equipment Rated More Than 1000 kVA: 3 ohms.
4. Substations and Pad-Mounted Switching Equipment: 5 ohms

D. Excessive Ground Resistance: If resistance to ground exceeds specified values, suitable and approved methods to reduce ground resistance shall be provided by this contractor.

END OF SECTION 260526

SECTION 260529 - SUPPORTING DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

B. Reference Division 7, section “Spray Fire-resistive Material” for coordination of all hangers or applicable supports.

1.2 DESCRIPTION

A. Provide products to suspend, attach, support and otherwise retain in location, electrical work.

1. The specified requirements herein include support and hardware information of a general nature. Where additional requirements are stated elsewhere in the specification related to specific products and conditions, such additional requirements shall supersede these general specifications.

B. Approvals: Obtain approval before cutting, drilling, or welding to, structural members. Where cutting, drilling, or welding is permitted, this work, as required for product support, is a part of product installation electrical work.

C. Welding: Use certified welders for welded installation. Steel in weld area shall be cleaned before and after welding operations, and refinished after welding.

1. Do not weld raceway pipe straps to structure.

2. Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.3 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 MATERIALS

A. Use expansion shield anchors or toggle bolts of the following manufacturers:

1. Phillips Drill Company, Inc. "Red Head Self Drilling"
2. Rawl Products Company "Saber Tooth"
3. McCulloch Industries "Kwik Bolt"

B. 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. Cooper B-Line, Inc.; a division of Cooper Industries.
    b. Thomas & Betts Corporation.
    c. Unistrut; Tyco International, Ltd.
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.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. 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) MKT Fastening, LLC.
        3) Simpson Strong-Tie Co., Inc.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        1) Cooper B-Line, Inc.
        2) Empire Tool and Manufacturing Co., Inc.
        3) Hilti Inc.
        4) ITW Ramset/Red Head
        5) MKT Fastening, LLC.
3. Mechanical Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.

7. Hanger Rods: Threaded steel.

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 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

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 (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 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 Section "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 INSTALLATION

A. Provide common support trapezes for parallel raceways.

B. Use manufactured preformed U-Channel system having accessory connecting and clamping devices available where parallel raceways are to be supported. Load channel system not to exceed manufacturer's recommendation.

C. Fabricate supports for transformers, panel boards, cable tray, lighting fixtures, cabinets, pull and junction loads, and similar electrical products from preformed U-Channel systems. Load on channel system not to exceed manufacturer's recommendations.

D. Support panelboards, disconnect switches, telecommunications, equipment, security, fire alarm panels, grounding bars and all other wall mount electrical equipment via ¾" primed and fire

treated plywood. Electrical equipment shall be mounted on said plywood in computer, telecommunication or electric rooms unless noted otherwise.

E. Use preformed U-Channel concrete inserts preset into forms to secure hangers suspended from slabs.

F. Use concrete expansion shield anchors or preformed U-Channel cast-in-place concrete inserts for attaching electrical products to concrete walls.

G. Support loads from stud anchors or concrete inserts at not to exceed manufacturer's live loading recommendations.

H. Do not use powder-charge driven fasteners. This includes anchors which are driven into place by any device which produces and impact force by use of compressed air, gas or any other propellant.

I. Do not drill holes or install driven fasteners in concrete at less than 12 inches from prestressed steel.

J. Do not use nylon or similar concrete inserts without prior approval, except for supporting 1 inch or smaller individual runs of conduit or tubing.

K. Use toggle bolts to attach supports for electrical products to hollow masonry walls. Do not attach products weighing more than 50 pounds to hollow masonry walls, without prior approval.

END OF SECTION 260529

SECTION 260533 RACEWAY & BOXES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements, Division 1 Specifications, apply to this Section.

1.2 DESCRIPTION

A. Provide concealed or surface mount raceway as required to complete work indicated on the Contract Documents. Installed raceways shall be plumb and level. Raceways and backboxes shall be provided for Technology, Fire Alarm, Security and Other Trades in non-residential spaces.

1. Raceways and backboxes shall be “RED” in color for all fire alarm related wiring.
2. Raceways and backboxes shall be “YELLOW” in color for all emergency circuits derived from emergency panelboards as noted within Contract documents.

B. All wiring shall be in conduit unless otherwise noted. Conduit shall be concealed in finished areas and may be exposed in unfinished areas such as mechanical and electrical areas. Conduit runs shall be continuous from outlet to outlet, fitting, pull or junction box, to cabinet or panel; and shall be mechanically secured electrically continuous.

C. Minimum conduit size is 1/2”. Where required, maximum lengths of 3 feet of ½” flexible conduit may be used for connecting instruments, sensors or associated control components.

D. Provide outlet boxes in the raceway systems wherever required for pulling wires and cables, making connections, mounting devices, lighting fixtures, controls or connecting miscellaneous equipment. Boxes installed shall be level and flushed mounted within wall cavities/partitions for wall mount devices as noted on plans.

E. Certain backboxes for the fire alarm systems shall be supplied by the respective equipment suppliers. Any boxes required for the respective systems and not furnished by the respective equipment suppliers shall be furnished and installed. It is this Contractor's responsibility to determine what boxes are and are not furnished by the respective equipment suppliers.

F. EC to provide all backboxes for Mechanical, HVAC and Plumbing equipment power and/or control devices.

G. Provide plaster rings as required in gypsum board partitions.

H. Coordinate box sizes with other equipment supplier as required.

I. All boxes associated with plastic conduits shall be PVC boxes with cast aluminum covers, complying with NEMA OS2.

J. Unless otherwise noted, backboxes for telecommunication, technology and security devices shall have extra deep capacity with a minimum size of 4”x4”.

1.3 GENERAL

A. Wherever the terms "conduit" or "raceway" appear hereinafter it shall be understood to mean any one, or combination of, the following type:

1. Rigid Galvanized Steel

2. Electrical Metallic Tubing
3. Flexible Metallic Conduit
4. Square Steel Raceway Duct
5. Liquid Tight Flexible Conduit with External Wrap Ground Wire
6. Surface Mounted Raceway
7. Metal Duct Wireway
8. Intermediate Steel Conduit
9. PVC Coated Rigid Steel Conduit
10. Rigid Non-Metallic Conduit (PVC)

B. The electrical contractor shall precisely record location of all feeders on legible submitted “As Built” plans at end of project.

C. Conduits shall not be supported by wire ties. All components including backboxes, pull boxes, panels and the like shall be independently supported from raceway.

D. Backboxes shall be suitably sized for device mounting, splicing and contain required volume for entering conductors.

E. Cuts made to metallic supports, equipment or field made conduit threads shall be sprayed with "cold-galvanize" or equivalent rust protection prior to assembly. Electrical contractor shall not leave untreated metal exposed to weather.

1.4 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. Maintain required safe working clearances and required dedicated equipment space as defined by the latest edition of National Electrical Code.
2. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
3. To provide for ease of disconnecting the equipment with minimum interference to other installations.
4. To allow right of way for piping and conduit installed at required slope.
5. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

C. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping.

E. Coordinate backbox requirements for technology and telecommunication devices as specified in Division 27.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Rigid Steel Conduit

1. Smooth surfaced heavy wall mild steel tube, of uniform thickness and temper, reamed and machine threaded at each end and protected inside and out with galvanizing,

sherardizing, or equivalent process. Rigid steel conduit shall comply with Article 344 of NEC.

2. Non permitted usage:

    a. Hazardous or corrosive environments.

B. Electrical Metallic Tubing (EMT)

1. Smooth surface, thin wall, mild steel tube, of uniform thickness and temper, galvanized or sherardized on the outside, and enameled on the interior. EMT shall comply with Article 358 of NEC.

2. Non permitted usage:

    a. Poured concrete.
    b. Exposed to weather.
    c. Underground.
    d. Exposed in mechanical or similar equipment rooms below 8ft from finish floor.
    e. Hazardous or corrosive atmosphere.

C. Flexible Metallic Conduit

1. Interlocking single strip, steel construction, galvanized inside and out, after fabrication. Conduit shall comply with Article 348 of NEC.
2. Allowed usage:

    a. Connection to lighting fixtures not over 3 feet in length.
    b. Narrow movable partitions where other raceways are not practical, when approved by Owner's representative.

D. Steel Square Raceway Duct

1. Square raceway duct shall be 4 x 4 inch minimum or sized as shown on plan. Duct shall be primed and finished gray baked enamel. Duct shall conform to Federal Specifications and have a hinged access cover on one side. Properly support from building. Complete with all necessary fittings.

E. Liquid Tight Flexible Conduit With Exterior Spiral Wound Ground Wire

1. Raceway with a circular cross-section having an outer liquid tight, non-metallic, sunlight-resistant jacket over an inner flexible metal core. Conduit shall comply with Article 350 of NEC.
2. Allowed usage:

    a. Connection to motors, controllers or panels located on dynamic equipment and transformers. All motor connections shall be water and dust tight with grounding lug fittings approved for wet location usage. Maximum length: 3 feet.

F. Surface Mounted Raceway (SMR)

1. Surface mounted raceways shall be used only where indicated within Contract documents with sizes required by the National Electrical Code. Raceways shall be totally enclosed and shall be complete with sectional barriers, connectors, fittings, bridges, couplings, conduit adapters, clips, hangers, transition fittings and required device plates for a complete installation.
2. Surface mounted raceways shall be of one manufacture with finish and construction type as noted.
3. Any unused openings to be closed by the Electrical Contractor with blank faceplates.

4. Raceways shall be installed in a neat and symmetrical manner. Feeds to raceways shall be concealed in walls, unless prohibited by wall construction. Installation shall comply with Article 378 of NEC.

G. Metal Duct Wireways

1. Wireways shall be used only where indicated with usage for mounting groups of switches and/or starters. Wireways shall be the standard manufactured product of a company regularly producing wireway and shall not be a local/remote shop-assembled/fabricated unit.
2. Wireways shall be of screw or hinged-cover types, UL listed, and of sizes indicated or otherwise required by the NEC. Finish shall be light-gray enamel over rust inhibitor.
3. Wireways installed in interior spaces shall be NEMA 12 or 3R if installed in an exterior environment.
4. Wireways shall be routed, provided with all necessary components and sized by the Electrical Contractor to accommodate all cables and wires per NEC.

H. Intermediate Steel Conduit

1. Smooth surface, intermediate wall, mild steel tube, of uniform thickness and temper, threaded at each end, and protected inside and out with galvanizing or equivalent process. Conduit shall comply with Article 342 of NEC.
2. Non permitted usage:
    a. Hazardous or corrosive environments.

I. Rigid Non-Metallic Conduit (PVC)

1. Rigid non-metallic conduit shall be designed for installation below ground and with or without concrete encasement. Rigid non-metallic conduit shall comply with Article 352 of the NEC.
2. Limited usage:
    a. In or under concrete slabs on grade.
    b. Exterior use when encased in 3 inch concrete.

J. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

K. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

L. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:
    a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
    b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

M. Outlet boxes specified herein refer generally to cast or pressed steel boxes of less than 50 cubic inch internal volume per gang. Refer to "Junction and Pull Boxes" for larger box specifications.

N. Outlet boxes where exposed to water or weather shall be approved for this use and shall be made of cast iron.

O. All exterior outlet boxes shall be watertight and dust tight with hinged gasketed covers similar to Thomas & Betts “WTD” Series, Crouse-Hinds or TayMac for two (2) GFCI outlets with integral

lock and shall be cast aluminum and threaded for rigid conduit similar to Thomas & Betts “LT” Series. There must be a gasket between the enclosure and the mounting surface and between the hinge cover and the mounting base plate. Enclosure shall be marked “UL listed” and “Suitable for wet locations while in use”.

2.2 ACCEPTABLE MANUFACTURERS

A. Rigid Steel Conduit: O-Z/Gedney, Wheatland Tube, Allied Tube and Conduit.

B. Intermediate Steel Conduit:, O-Z/Gedney, Wheatland Tube, Allied Tube and Conduit.

C. Electrical Metallic Tubing: O-Z/Gedney, Wheatland Tube, Allied Tube and Conduit. Steel compression type only, concrete tight with non-insulated throat.

D. Flexible Metallic Conduit: ACME, International, Electri-Flex

E. Flexible Conduit, Liquid Tight: Anaconda "Sealtight," National Electric, Coleman Cable and Wire Company.

F. Steel Square Raceway Duct: Square D, Hoffman Engineering Company, Cooper B-Line.

G. Surface Mounted Raceway: Wiremold v700 series or dual channel non-metallic 5400 series, “white” (unless noted otherwise within Contract Documents), Siemon or Panduit Corp.

H. Wireways: Hoffman, Hammond Manufacturing, Panduit or approved equal.

I. PVC coated rigid steel conduit; Occidental Coating Company, Robroy Industries, or equal.

J. Rigid Non-Metallic Conduit (PVC): Allied, Cantex, Prime Conduit

K. Pressed Galvanized Sheet Steel Boxes: Appleton Electric, Bowers Manufacturing Company, Steel City, or equal.

L. Cast Iron Boxes: Crouse Hinds, Appleton, Thomas & Betts, or equal.

M. Outlet boxes manufactured to provide mounting for special devices are specified with the product affected.

N. Outlet boxes for nonmetallic conduit: Carlon Electric Sciences, Inc.

O. PVC coated outlet boxes; Occidental Coating Company, Robroy Industries, or equal.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, non-corrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 USE

A. The following shall be used as a minimum guideline for the installation of raceways:

1. In metal stud and masonry walls:

a. Electrical Metallic Tubing (EMT).
b. Intermediate Steel Conduit (IMC).
c. Rigid Steel Conduit.

2. Above plaster, drywall, lay-in and furred ceilings:

   a. Electrical Metallic Tubing (EMT).
   b. Intermediate Steel Conduit (IMC).
   c. Rigid Steel Conduit.

3. Where exposed in dry locations:

   a. Electrical Metallic Tubing (EMT).
   b. Intermediate Steel Conduit (IMC).
   c. Rigid Steel Conduit.

4. Where exposed in dry locations of storage rooms, mechanical equipment rooms, electrical equipment rooms, etc.

   a. Intermediate Steel Conduit (IMC).
   b. Rigid Steel Conduit.

5. Feeders and service entrances encased in concrete:

   a. Rigid Steel Conduit.
   b. Rigid Non-Metallic Conduit (PVC).
   c. Rigid Poly-Vinyl Chloride (PVC) Coated Steel Conduit.

6. Branch circuits in direct contact with earth.

   a. Rigid Steel Conduit.
   b. Rigid Non-Metallic Conduit (PVC).
   c. Rigid Poly-Vinyl Chloride (PVC) Coated Steel Conduit.

7. Where installed in non-conditioned type areas such as parking garages, transformer vaults, loading docks, etc.:

   a. Rigid Steel Conduit. (RSC).
   b. Rigid Poly-Vinyl Chloride (PVC) Coated Steel Conduit.

8. All interior feeders in excess of 600 volts:

   a. Rigid Steel Conduit (RSC).

9. In short lengths (not to exceed 3'-0") for final connections to equipment subject to vibration:

   a. Flexible Metallic Conduit.
   b. Liquidtight Flexible Metallic Conduit (Sealtight).

10. In locations where structural or existing conditions prevent the use of rigid conduit, intermediate metallic conduit or electrical metallic conduit. (In cases where flexible conduit is used, prior written approval of the Owner’s representative shall be required):

    a. Flexible Metallic Conduit.

11. Where exposed to weather on rooftops, sides of buildings, etc.:

    a. Rigid Steel Conduit (RSC).
    b. Rigid Non-Metallic Conduit (PVC).
    c. Rigid Poly-Vinyl Chloride (PVC) Coated Steel Conduit.

12. In short lengths for final connections (not to exceed 3'-0") to equipment subject to vibration and exposed to oil or moisture.

a. Liquidtight Flexible Metallic Conduit (Sealtight).

13. For connections (not to exceed 3'-0") to kitchen equipment, lab equipment, etc.

a. Liquidtight Flexible Metallic Conduit (Sealtight).

14. Branch circuits in direct contact with earth and under roadways.

a. Rigid Steel Conduit encased in concrete.
b. Rigid Non-Metallic Conduit encased in concrete.
c. Rigid Polyvinyl Chloride (PVC) coated steel conduit encased on concrete.

15. Use 3/4 inch minimum trade size conduit unless otherwise noted or specified. In any case, use conduit of sufficient cross section to prevent insulation damage by abrasion and deformation during pulling.

16. Use rigid non-metallic conduit from SPD to building system ground.

3.2 INSTALLATION

A. 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.

B. 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.

C. The actual runs and locations of conduit, lines, and equipment shall be determined on the site and shall be installed to meet the various conditions at the building. Any changes necessary to conceal conduit or clear existing pipes, equipment or construction shall be made.

D. Do not reduce conduit sizes where indicated as larger than required by Code for conductors indicated to be installed. Electric design may have over-sized raceway to permit future added conductors.

E. Raceways shall be installed plumb, level, parallel or right angles to nearby surfaces or structural steel following surface contours as much as possible. Use insulating bushing to protect conductors when joining raceways with fittings designed and approved for that purpose. Joints hall be made wrench tight.

F. Support individual conduit 1 inch and smaller by securing with one-hole malleable iron or pressed steel type straps. Use screws and inserts on concrete or masonry construction, approved clamps or clips on steel construction, or other approved means.

G. Attach conduit larger than 1 inch to framing members, using approved split ring pipe hangers or 2-hole malleable iron or pressed steel straps.

H. Use 3/8 inch minimum hanger rod for 2 inch and smaller individual conduit support and 1/2 inch rod for larger individual conduit support. Use preset concrete inserts to support hanger rods. Where inserts are required after placement of concrete, use expansion shield type anchors.

I. Do not use perforated plumbers tape to support conduit.

J. Use beam clamps of steel, cadmium-plated or galvanized for attachment to beams and columns.

K. Do not employ running threads for conduits.

L. Cut ends square, ream and shoulder in fittings.

M. Provide conduit expansion fittings at building expansion joints, where necessary to compensate for thermal expansion and contraction or where continuous conduit runs exceeds distances as recommended by manufacturer. Metal raceways shall remain electrically continuous by means of approved bonding jumpers where expansion fittings are used.

N. Install conduit and tubing in a manner which shall not trap moisture due to coupling leakage or condensation. Make conduit joints in earth, concrete, masonry, or exposed on exterior, gas tight.

O. Conduit shall be supported at intervals of not more than 10 feet or as otherwise required by National Electrical Code. Flexible steel conduit shall be supported at intervals of not more than 3 feet. No conduit or outlet boxes shall be attached to ductwork, piping, or mechanical equipment, unless specifically approved. Support 1-1/4 inch and smaller size within 18 inches of outlets, and 1-1/4 inch or larger sizes within 36 inches of terminations. Do not support conduit from ceiling suspension systems, except that short lengths of flexible conduit for lighting fixture connections may be so supported.

P. Use cast metal boxes and cast metal fittings for right angle direction changes and for tee, or cross-connections for exposed conduit except where pressed steel boxes are permitted by this Specification. Use factory elbows or field bends only when approved to fit job conditions.

Q. Do not install bends visibly deformed from true circular cross-section. Make field bends with conduit hand or power bender. Minimum bending radius for power, lighting, and the fire alarm shall be as required by Code.

R. Minimum bending radius for telephone and data shall be:

1. Not less than 10 times diameter for conduit 2-1/2 inches and larger.
2. Not less than 20 times diameter for conduit 2 inches and smaller.

S. Clearance from all mechanical piping including steam, gas, refrigeration, hot water, chilled water, etc., shall not be less than 6 inches and 4” from cross piping.

T. Conduits to motors in Mechanical Equipment Rooms shall run exposed.

U. Exposed conduits shall be plumb, level, parallel with or at right angles to building line, beams, or ceilings. Symmetrical bends or metal boxes shall be placed at changes in direction or taps. Positively no conduit shall be run exposed on the exterior face of building unless otherwise pre-approved by the Architect.

V. Conduit terminals at boxes, cabinets, and in general to wiring enclosures, shall be rigidly secured with double locknuts and bushings or approved fittings. Conduits shall be screwed in and shall engage at least five threads in hub where conduit boxes with threaded hubs are used. Insulating bushings shall be used for conduits 1-1/4 inch or larger, and for conductors larger than 10 AWG, and in cases where wiring is subject to vibration.

W. Provide independent support for conduit rising from floor for motor connection if over 24 inches above floor. Do not support to a motor or ductwork which may transmit vibration.

X. Close ends and openings against entry of construction debris, until access is required for installation of conductors or pull wires.

Y. Do not install across ventilation openings or other foreign systems in electrical clearance areas as specified in NEC Article 110.26.

Z. All wiring, unless otherwise noted, shall be installed in rigid metal conduit, intermediate metal conduit or EMT as outlined in this specification and subject to the restriction of the NEC. Minimum size raceways shall be 1/2 inch unless otherwise noted or specified. In any case, use conduit of sufficient cross section to prevent insulation damage by abrasion and deformation during pulling.

AA. All surface and flush mounted panelboards shall have a minimum of six (6) 1" diameter conduits stubbed to nearest accessible ceiling location.

BB. Empty conduit runs shall have heavy nylon, polypropylene or monofilament pull cord with not less than 200 lbs. tensile strength. Leave at least 12" of slack at each end of pull cord tied to end of each raceway.

CC. Field bend non-metallic conduit in accordance with the manufacturer's recommendations using heater and bending devices designed and approved for the purpose. The use of torches or other flame-type devices shall not be permitted. Use internal bending plugs on 2 inch conduit and larger to prevent crimping.

DD. To make joint in non-metallic conduit, use Solvent Cement as recommended by the conduit manufacturer. Be sure conduit ends are clean, dry, and cut at the right angle to the centerline of the conduit. Apply coat of Solvent Cement the length of the socket to be attached. Push conduit firmly into fitting while rotating conduit slightly about one-quarter turn to spread cement evenly. Allow joint to set before proceeding.

EE. Vertical conduits through floor slabs shall be through sleeves sealed with DOW "RTV" or "Chase Foam". Sleeves shall extend 1" above the finished floor. Multiples of conduit risers may be run through floor openings with concrete or metal curbs of 4 inches in height and closed with insulated fire proofing steel plates. Seal water and moisture tight all conduits entering from outside the building to a conditioned space.

3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: 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. Roof mounted equipment shall have conduit routed to the equipment within the equipment curb where possible. If a roof penetration must be made, it shall be installed with a pipe seal flashing kit designed for the purpose.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using [steel] [cast-iron] pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.4 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.

3.5 UNDERGROUND WORK

A. Underground work shall include excavating, concrete envelopes, raceways, cables, and backfilling required under this Contract unless noted otherwise. The Electrical Contractor shall be responsible for clearing new and/or existing underground service lines such as gas, water service, sanitary and storm water piping. Excavation shall be as set forth under “Special Conditions/Requirements.” Excavations shall be properly barricaded and protected to protect persons from injury. Follow rules of authorities having jurisdiction for safety standards. Excavation shall be on an unclassified basis.

B. Trench excavations shall be made open to proper alignment and grade. Trenches shall be of sufficient width to provide free working space on each side of the raceway structure for concrete envelope forms if required. In earth excavation, the trench shall be carried to a point 6 inches below the bottom of the structure envelope. Raceway structures shall not be allowed to rest directly upon rock, but shall be cushioned by a 6 inch layer of selected crushed stone or gravel. The on-site Owner’s representative shall govern the number of points at which the Contractor shall be permitted to work and the length of continuous open trench.

C. Raceways shall be firmly supported above the trench bed and separated from each other by means of approved spacers installed at intervals not exceeding 5 feet.

D. Raceway banks shall be encased in minimum of 3000 PSI concrete envelope not less than 3 inches thick all around the outside limits of the raceway group. In all instances, the concrete

shall be not less than 3 inches between any surfaces of a raceway. Underground structures shall be so installed that the top of the enclosing concrete envelope shall not be less than 30 inches below finish grade or otherwise required by code or local AHJ's. Exiting of raceways from concrete slab shall be made with rigid galvanized steel elbows.

E. Concrete envelopes shall be reinforced at points where they cross fill or loose soil, foreign piping, or under vehicular roadways. Reinforcing shall be of size and extent indicated within Contract documents and shall extend 6 feet beyond each limit of fill, roadway, and/or foreign pipe. Where excavation for building purposes is below required grade for duct and manholes, and fill is to be placed under another contract, the Electrical Contractor shall be responsible for determination of satisfactory bearing conditions, and construct in accordance with preceding requirements.

F. Excavations shall be backfilled to finished grades. Backfill shall consist of screened excavated materials approved for backfilling consisting of earth, loam, sandy material, soft shale, or other approved materials, free from large clods of earth or stone. Backfill shall be brought up on approximately 6 inch layers and compacted. Any trenches improperly backfilled or where settlement occurs shall be reopened to the depth required for proper compaction, then refilled and compacted. Refer to Division 3 "Concrete" and Division 31, "Earthwork" for backfill and compaction requirements.

G. Open trenches under roadways or paved areas shall be backfilled as specified above, except that the entire depth of trench shall be backfilled in 6 inch layers, each layer moistened and compacted to a density at least equal to that of the surrounding earth and in such manner as to permit rolling and compaction of the filled trench together with the adjoining earth to provide the required bearing value so that paving of the area can proceed immediately after backfilling is completed.

H. Identification for conduits for medium voltage feeders.

1. Provide self adhesive or painted sign reading "HIGH VOLTAGE" red on white, size ½ height of conduit diameter.
2. Signs shall be provided at 20 foot intervals on accessible conduits and on armored cable in cable trays.

3.6 OUTLET BOXES

A. Do not install boxes smaller than permitted by National Electrical Code. Where no outlet box size is indicated or specified, install a box of not less than 4 inches square by 1 1/2 inches deep dimensions. In dry locations, use pressed galvanized steel boxes, with drilled and tapped ears, and manufacturer's pre punched knockouts. In wet locations, for exposed interior locations below 4 feet above floor, and where poured into exterior concrete, use cast metal boxes with threaded hubs.

B. Provide pressed steel outlet boxes with tile ring where installed in brick, tile, marble, and similar material and in masonry block walls. Equip with plaster rings where plaster or drywall finish is indicated. Select rings of proper depth to place front of ring even with the plane of the finish surface. Select style of ring to match device and finish plates to be installed. Boxes shall be installed plumb, level and flush with wall surface.

C. Close unused openings in pressed steel boxes with knockout closure and in cast boxes with threaded plugs.

D. Gaskets for cast metal boxes may be omitted where installed in dry locations.

E. Use concrete type boxes where required to clear and not displace reinforcement.

F. Use multiple gang boxes for grouping devices at one location. Provide barriers between different systems and between adjacent devices when the voltage between adjacent exposed live parts exceeds 300 volts to ground.

G. Support ceiling outlet boxes flush with the ceiling plane. Use approved bar hanger or other approved means to provide adequate support for lighting fixtures or other products attached to ceiling outlet boxes. Equipment boxes with fixture studs where required by the lighting fixtures to be installed. Support boxes in suspended ceiling systems from main runner channels, or joists or other structural members. Do not support from the ceiling suspension system support wires or tile support tees or similar light weight ceiling components, unless the components are designed and approved for this purpose.

H. Provide outlet boxes used as junction boxes with blank device plates if installed flush, and with blank galvanized covers if installed on the surface. Use raised covers on surface boxes in finished areas. Flat plates may be used on surface boxes in machine rooms, electrical rooms, and similar unfinished areas.

I. Provide outlet boxes with bushed cover plates where used for systems requiring an exposed cable connection from the box.

J. Locate outlet boxes so that they shall be readily accessible. Boxes over suspended ceiling systems are considered readily accessible if the ceiling tile removal permits ready access to such boxes.

K. Use PVC coated junction boxes in conjunction with PVC coated rigid steel conduit and fittings.

L. Individual circuits are shown on plans for clarity. Branch circuit “home runs” maybe grouped together (unless noted otherwise) and extended to panels as shown.

3.7 FLOOR BOXES

A. Provide box with protective removable concrete cover. Pour and trowel concrete so cover is flush with concrete. Remove cover after concrete is set and adjust box flush with final floor surface. Where installed in “other” floor types box shall be fully supported and secured with final assembly matching surface of finish floor. Installation of floor box must conform to manufacturer’s specifications and shall be flush with final floor finish. Box type and configured service ports as specified in Section 262726 “Wiring Devices”.

3.8 PROTECTION

A. Provide final protection and maintain conditions that ensure coating, 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 manufacture.

B. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacture.

END OF SECTION 260533

SECTION 260534 - JUNCTION & PULL BOXES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION

A. Provide junction and pull boxes in accordance with Contract Documents. Wherever possible, use outlet boxes for junction and pull boxes Fuses in equipment shall be furnished by the respective contractor supplying the device and installed under this Division.

B. Provide cabinets in accordance with the Contract Documents. Cabinets for same type of use shall be the product of a single manufacturer. Do not install surface mounted cabinets in finished areas, unless indicated. Where conflicting data is indicated, verify mounting requirements prior to ordering cabinets.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Sheet Steel Junction and Pull Boxes: Hoffman, Hammond Mfg, Steel City or approved equal.

B. Cast Iron Junction and Pull Boxes: O.Z. Electric Manufacturing Company, Crouse Hinds Company, or equal.

C. Rigid Nonmetallic Junction and Pull Boxes: Carlon Electric Sciences, Inc. Hubbell, Cantex Industries or equal.

D. Underground Junction Boxes: Quazite Incorporated or approved equal.

1. Junction or hand-hole boxes shall be “Tier-15” rated and installed to withstand all loads likely to be imposed meeting the requirements of 2011 NEC, ANSI/SCTE 77-2002 and UL. Underground box shall be NEMA 4 constructed of non-corrosive polymer concrete and reinforced by a heavy weave fiberglass. Cover shall be gasketed and recessed cover bolts shall be stainless steel. Cover shall be flush with sidewalk, landscaping or surrounding surface. Cover logo shall say reflect contents such as “COMMUNICATION”, “ELECTRIC” or as noted within Contract documents. Box shall be ribbed externally and internally for rigidity, shall be able to be drilled to accept mounting brackets without impairing strength. Cover and box shall be ultraviolet protected. Conduits shall enter bottom of lower unit using a long-sweeping ell fitting.

E. Cabinets: Products of the following manufacturers are acceptable. Other products shall be approved as equal.

1. Cabinets for General Use: Hoffman Engineering Company, Hammond Manufacturing, or equal.

2. Cabinets for systems and/or products, use cabinets furnished by manufacturer with system or product. Where system or product cabinets do not comply with these

specifications, submit cabinet shop drawings, indicating deviations, and obtain approval for their use.

2.2 MATERIALS

A. Fabricate sheet metal junction and pull boxes of galvanized, Code gauge, sheet steel. Include angle iron framing where required for rigidity. Boxes shall not deflect or deform when covers are removed after conduit and conductors are installed, and any deflection occurring shall not prevent the easy installation and removal of cover attachment screws.

B. Size junction and pull boxes to not less than minimum National Electrical Code requirements. Increase size above Code requirements where necessary to provide space for pulling, racking, or splicing enclosed conductors, or where specified or indicated dimensions exceed Code requirements.

C. Metal junction and pull boxes exposed to weather shall be listed for use such as (and not installed in or below grade) raintight, weatherproof or waterproof. Boxes shall contain gaskets with removable covers. Use boxes constructed to meet NEMA 3R requirements or otherwise noted or required by code. Equivalent gasket boxes or boxes of similar design permanently rendered weatherproof. Raintight or weatherproof boxes shall use threaded watertight hubs for top or side entry and may use knockout for bottom entry only. For exterior pull boxes, use a minimum of 14 gauge galvanized sheet steel. Apply galvanizing by the hot dip process after fabrication.

D. Surface sheet metal junction and pull boxes with covers aligning with the sides of the box and equip flush boxes with covers extending 3/4 inch all around the perimeter of the back box. Provide sufficient cover attachment screws to ensure that box covers contact the surface of the box for the entire perimeter of the enclosure. Use brass or stainless steel screws to attach covers to boxes.

E. Use brass screws only to attach junction and pull box covers to interior floor boxes or boxes located where moisture may be present.

F. Do not use single covers for junction and pull boxes having cover length or width dimension exceeding 3 feet so specified, indicated, or approved. Sectionalize covers that exceed 3 feet in either dimension into two or more sections.

G. Provide barrier between pull boxes for cables of different voltage and to separate cables connected to the emergency and normal power.

H. Provide split or hinged covers on junction/pull boxes when the cover exceeds eight (8) square feet in area.

I. This contractor shall paint all fire alarm system junction boxes, pull boxes and covers in red paint in accordance to Ohio Building Code.

J. Indoor Cabinets:

1. Construct of cold rolled quality steel, with metal gauges and construction methods conforming to National Electrical Code requirements, and Underwriters' Laboratory standards.
2. Finish doors, trims, and back boxes for surface mounted cabinets in finished areas, by applying a rust resistant treatment, prime coat, and a final coat of manufacturer's standard enamel or lacquer finish. Galvanize all other sheet metal components of cabinets, excepting non ferrous metal parts, or steel parts provided with cadmium plating or equivalent protective plating.

3. Equip doors with concealed or semi concealed hinges and with flush or semi flush spring catch type flush cylinder locks. Key cabinet doors of similar use alike, and provide two keys with each lock.
4. Set cabinet doors flush into cabinet trim. Equip trim with adjustable clamps or other approved means to fasten trim to cabinets. Fastening method shall permit adjustment for aligning the trim of flush cabinets to a plumb position. Trim for flush cabinets shall extend not less than 3/4 inch beyond the perimeter of the back box.
5. Do not use factory furnished knockouts with surface back boxes. Punch or drill required openings during installation. Equip flush back boxes with manufacturer's standard pattern of knockouts.

K. Outdoor Cabinets:

1. Cabinets shall be constructed of 12 gauge, Type 304 stainless steel, reinforced as necessary in large sizes.
2. Cabinet shall have gaskets, etc., required to meet NEMA Type 4 and UL 508 requirements.
3. Cabinets shall be of size indicated within Contract documents meeting minimum code requirements plus 25 percent growth.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate interior junction and pull boxes in machine rooms, equipment rooms, storage rooms, electrical rooms, and similar utility spaces, unless otherwise indicated or approved. Fasten plates to boxes with countersunk flat head screws. Provide plates with 3/4 inch trim all around.

B. Do not exceed the equivalent of three 90deg bends between general wiring pull and junction boxes, and reduce to not more than the equivalent of two 90deg bends where telephone or other multi conductor cable shall be installed.

C. Install junction boxes and pull boxes in a manner to insure that equipment ground continuity is maintained.

D. Junction and pull boxes shall be accessible.

E. Boxes shall be installed every 100 feet in major feeders.

F. Underground junction boxes shall be installed according to manufacturer's instructions.

G. Support all junction/pull boxes with 1/2 inch all-thread rod from floor above or joists or structural members. If mounted tight to floor above, use approved anchors. Tie wire used to support, suspend, or secure junction/pull boxes is not acceptable.

H. Cabinets:

1. Set cabinets at heights indicated or specified. In the absence of such information, set cabinets at not to exceed 6 feet 6 inches from finished floor to top of cabinet.
2. Level and align the tops of cabinets in sight of each other at a uniform height.
3. Install cabinets (and other enclosure products) plumb with building construction. Install flush enclosures so that the trim shall rest against the surrounding surface metal around the entire perimeter of the enclosure.
4. Fastenings shall be made by means of not smaller than 3/16 inch diameter bolts, expansion bolts, or toggle bolts; not smaller than No. 9 x 1 inch wood screws.

Fastenings, where exposed to weather or moisture, shall be galvanized. Not less than four fastenings shall be used to secure each cabinet. Do not use nails, or wooden fiber inserts in masonry.

5. On masonry or concrete walls, columns or flooring, fastenings shall be made by means of lead expansion shields not smaller than shield size 3/8 inch diameter by 5/8 inch long for use with No.10 24 round head machine screws. Machine screws shall be not less than 1-1/4 inches long for installation on ceiling and not less than 1 inch long elsewhere.
6. Holes for lead expansion shields shall be carefully and accurately drilled, using sharp drills to a depth which shall afford the maximum practical engagement of threads (depth equal to screw length not less than 1 1/4 inches past plaster into solid concrete). Installation shall develop full strength of screws.

END OF SECTION 260534

SECTION 260535 - RACEWAY & FITTINGS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements, Division 1 Specifications, apply to this Section.

1.2 DESCRIPTION

A. Provide all raceway fittings, supports and back boxes required to complete work indicated on the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Subject to general requirements and use as specified in Section 260533 “Raceway and Boxes”.

B. For fittings of specialized type, use the products as scheduled for each type under "Manufacturers," or approved equal.

2.2 MANUFACTURERS

A. General Use Fittings: Steel City, Thomas & Betts, O.Z. Electric Manufacturing Co., Carlon, Sealing Fittings: Appleton Electric, Crouse-Hinds.

B. Liquid-Tight Flexible Conduit Fittings: Thomas & Betts, Appleton Electric, Steel City.

C. Expansion Fittings: O.Z. Type "DX" or approved equal of Appleton, Thomas & Betts, Crouse Hinds.

D. Cast Metal Straight, Tee, Cross, and Fittings: Crouse-Hinds, Appleton Electric, Killark.

E. Rigid Nonmetallic Conduit Fitting: Carlon Electrical Sciences, Inc. Cantex Industries, Hubbell.

F. PVC coated fittings: Occidental Coating Company, Robroy Industries, Ocal (Thomas & Betts) or equal.

PART 3 - EXECUTION

3.1 USE

A. Use threaded fittings for rigid and intermediate metal conduit.

B. Compression or drive-on watertight fittings shall be used for metallic tubing. Fittings with set screws for trade size smaller than 2 inch is not approved for use.

C. Fittings for flexible conduit as approved by the enforcing Code official.

D. Use fittings made of the same material and corrosion resistance as the raceway except:

1. Malleable iron and steel are interchangeable.
2. Die cast fittings may be used for flexible steel conduit, and for factory manufactured offsets.
3. Use insulated bushings for conduit trade sizes.
4. Use steel insulated throat connectors for electrical metallic tubing.

E. Use steel fittings that are galvanized, cadmium-plated, or have other approved protective coating.

F. Use double locknuts for terminating rigid conduit at sheet metal enclosures and equipment conduit ends with bushings.

G. Provide expansion fittings on every raceway larger than 1-1/2 inches, and use a 2 foot piece of seal tight on all conduit routings 1-1/2 inches and smaller where it crosses any building expansion joints. Expansion fittings shall be provided for conduit thermal expansion or contraction in accordance to tables specified in NEC. Verify exact location of building expansion joints prior to installation of raceway with project Architect.

H. Where an expansion fitting is used, conduit bonding shall be continuous by means of a flexible braided copper bonding strap with ground clamps. Bonding strap and clamps shall be provided for grounding continuity as required by NEC. Strap shall be of sufficient length to allow full expansion. Manufacturer Crouse-Hinds XJ or XJG-EMT or approved equal.

I. Use PVC coated fittings for rigid PVC coated steel conduit.

J. Provide moisture barrier fittings for conduit routing entering conditioned spaces from non-conditioned spaces. This contractor shall fill fitting with an approved material preventing circulation and formations of moisture in the conduit system.

K. Where conduit is subject to collection of condensation or moisture, provide a low point combination breather/drain such as Crouse-Hinds ECD or equal.

END OF SECTION 260535

SECTION 260553 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Schedule of Nomenclature: An index of electrical equipment and system components used in identification signs and labels.

C. Samples: For each type of label and sign to illustrate color, lettering style and graphic features of identification products.

1.3 ALQUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

C. Comply with ANSI A13.1 and NFPA 70 for color-coding.

PART 2 - PRODUCTS

2.1 RACEWAY AND CABLE LABELS

A. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

1. Color: Black letters on orange field.
2. Legend: Indicates voltage.

B. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend over-laminated with a clear, weather- and chemical-resistant coating.

C. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1inch to 2 inches wide.

D. Provide conduit labels for voltages greater than 115 volts. Labels to indicate voltage and shall be pre-tension acrylic/vinyl construction coiled to completely encircle conduit diameters through five inches or pre-molded to conform to the circumference of six inch conduits.

2.2 NAMEPLATES AND SIGNS

A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.

B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.

C. Fasteners for Nameplates and Signs: Self-tapping, stainless steel screws of No. 10/32, stainless steel machine screws with nuts and flat and lock washers.

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch.
2. Tensile Strength: 50 lb. minimum
3. Temperature Range: Minus 40 to plus 185° F.
4. Color: According to color-coding.
5. Paint: Formulated for the type of surface and intended use.

    a. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.
    b. Primer for Concrete Masonry Units: Heavy-duty resin block filler.
    c. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.
    d. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. 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.

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 applying.

E. Color Banding Raceways and Exposed Cables: Band exposed and accessible raceways of the systems listed below:

1. Bands: Colored adhesive tape. 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 feet maximum intervals in straight runs, and at 25 feet 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. Mechanical and Electrical Supervisory System: Green and blue
    d. Telecommunication System: Green and yellow.

F. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.

G. Circuit Identification Labels Installed internally backside of wall plates within finished areas, external within unfinished areas unless noted otherwise.

1. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.
    a. Exposed Outlet Boxes: Pressure-sensitive, self-adhesive plastic label on wiring device cover.
    b. Concealed Boxes: Plasticized card stock tags.

H. Color Coding of Secondary Phase Conductors: Use the following colors for feeder and branch circuit phase conductors.

1. 208/120-V Conductors:
    a. Phase A: Black
    b. Phase B: Red
    c. Phase C: Blue
    d. Neutral: White
    e. Ground: Green

2. 480/277-V Conductors:
    a. Phase A: Brown
    b. Phase B: Orange
    c. Phase C: Yellow
    d. Neutral: Gray
    e. Ground: Green

I. 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.

1. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6” from terminal points and in boxes where splices or taps are made. Apply last two (2) 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.

J. Power-Circuit Identification: Metal tags or aluminum wrap- around marker bands for cables, feeders and power circuits in vaults, pull and junction boxes, manholes and switchboard rooms.

1. Legend: 1/4” steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
2. Tag Fasteners: Nylon cable ties.
3. Band Fasteners: Integral ears.

K. 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.

L. 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" high lettering for emergency instructions on power transfer and other emergency operations.

M. Fire alarm junction boxes: All fire alarm system junction boxes and cover plates shall be painted red.

N. Service Equipment:

1. Plaque: Provide directory plaque in accordance to NFPA 70-225.37 where building has more than one service.
2. Disconnecting Means: Each service disconnect means shall be permanently identified meeting the requirements of NFPA 70-230.70(B).

O. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes distribution, branch, lighting, communication, signal and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2" high lettering on 1-1/2" high label; where two (2) lines of text are required, use labels 2" high. Use black lettering on white field. Apply labels for each unit of the following categories of equipment using mechanical fasteners.

1. Panelboards, electrical cabinets and enclosures
2. Access doors and panels for concealed electrical items
3. Electrical switchgear and switchboards
4. Emergency system boxes and enclosures
5. Automatic transfer switches
6. Lighting control panels
7. Motor-control centers
8. Disconnect switches
9. Enclosed circuit breakers
10. Motor starters
11. Push-button stations
12. Contactors
13. Remote-controlled switches
14. Dimmers
15. Control devices
16. Transformers
17. Fire alarm master station or control panel
18. Variable frequency drives
19. Manual motor starting switches
20. Manual operation switches
21. Dedicated circuits

P. Panelboard Schedules:

1. Panelboard schedules shall be revised reflecting final alterations, additions and load balancing. Schedules shall include identification of service loads, wattage and/or HP, pole quantity, amperage and shall be type written. Compliance shall be in accordance to NEC article 408.4.

END OF SECTION 260553

SECTION 26 08 00 – COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to Section 01 91 13 “Commissioning” for all specific requirements required associated with the commissioning process that will be required as part of this work. As part of this project, participation in the commissioning process as described in Section 01 91 13 shall be required.

1.2 SUMMARY

A. Section includes commissioning process requirements for electrical systems, assemblies, and equipment.

B. Related Sections:
1. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.

1.3 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CxA: Commissioning Authority.

C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.

D. DDC: Direct Digital Controls.

E. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 ALLOWANCES

A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Division 01 Section "Allowances."

1.5 UNIT PRICES

A. Commissioning testing allowance may be adjusted up or down by the "List of Unit Prices" Article in Division 01 Section "Unit Prices" when actual man-hours are computed at the end of commissioning testing.

1.6 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase coordination meetings.

C. Attend testing review and coordination meetings.

D. Participate in Electrical systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

E. Provide information requested by the CxA for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.7 CxA'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual Electrical systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing, adjusting, and balancing of Work are complete.

D. Provide test data, inspection reports, and certificates in Systems Manual.

1.8 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:
   1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
   2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
   3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for Electrical systems, assemblies, equipment, and components to be verified and tested.
   4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
   5. Certificate of readiness certifying that Electrical systems, subsystems, equipment, and associated controls are ready for testing.
   6. Test and inspection reports and certificates.
   7. Corrective action documents.
   8. Verification of testing reports.

1.9 SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

1.10 COMMISSIONING AUTHORITY

A. Motz Engineering acting in conjunction with the Xavier University will take the role of the Commissioning Authority for this project. The Commissioning Authority will respond to all issues directly to the Owner and shall have the authority to grant final acceptance of each system commissioned.

1.11 COMMISSIONING PLAN

A. The project Commissioning Plan is included in Section 01 91 13 as a reference for information only. This section and sections in other Divisions shall outline the work required for the project, consistent with the Commissioning Plan. Any discrepancies between the Commissioning Plan and the Project Manual sections shall be brought to the attention of the Commissioning Agent for clarification.

1.12 COORDINATION

A. All Prime Contractors and appropriate Subcontractors shall be responsible for cooperating and coordinating their work during the installation and commissioning process. Refer to the specific requirements and other sections for required work associated with coordination of installation work and preparation of Coordination Construction Drawings by the contractors.

B. The Commissioning Authority will participate in the coordination of installation work as necessary to insure the installation of system components meet the Owner's project requirements and will provide a facility that has appropriate access and means for future maintenance and service by Owner.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Certify that Electrical systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that Electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify that testing procedures have been completed and that testing reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 TESTING VERIFICATION

A. Provide technicians, instrumentation, and tools to verify testing of Electrical systems at the direction of the CxA.
   1. The CxA will notify Electric Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
   2. The Electric Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
   3. Failure of an item includes a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing.
   4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of Electrical testing shall include entire Electrical installation.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors and the fire alarm system.

D. Tests will be performed using design conditions whenever possible.

E. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

F. The CxA may direct that set points be altered when simulating conditions is not practical.

G. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

H. If tests cannot be completed because of a deficiency outside the scope of the Electrical system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

I. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 ELECTRICAL SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. The following Electrical systems shall be commissioned:
   1. Lighting Control Systems.

END OF SECTION 26 08 00

SECTION 260923 - 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. Reference specification Division 26 Section 262726 “Wiring Devices”.

1.2 SUMMARY

A. This Section includes the following lighting control devices:

1. Time switches.
2. Photoelectric switches.
3. Indoor occupancy sensors.
4. Lighting contactors.
5. Emergency shunt relays.
6. Outdoor motion sensors.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

C. US: Ultrasonic.

D. DT: Dual technology PIR & US

1.4 SUBMITTALS

A. Product Data Sheet: Submit data sheet(s) for each type of lighting control, sensors, required relays and controllers.

B. Shop Drawings: Provide installation plan drawing with layouts and details for each room or area having lighting controls. Each drawing shall include location of controls, light fixtures, sensors and other required equipment. Include bill of material identifying products used with cross-reference to product data sheets. Wiring schematics shall be included for each type of control scheme.

C. Operation and Maintenance Data: Provide for each product used within project shall have 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 (Selected Types Where Applicable)

2.1 INTERIOR DIMMING SWITCHES

A. Reference specification Division 26 Section 262726 “Wiring Devices”.

2.2 TIME SWITCHES

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

1. Area Lighting Research, Inc.; Tyco Electronics
2. Intermatic, Inc
3. Leviton Mfg. Company Inc
4. TORK. Plate, Inc.
5. Hubbell Automation
6. Watt Stopper

B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.

1. Contact Configuration: DPDT
2. Contact Rating: 30A ballast load, 120/240-V AC
3. Program: 2 on-off set points on a 24-hour schedule.
4. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
5. Astronomic Time: All channels.
6. Battery Backup: For schedules and time clock.

C. Electromechanical-Dial Time Switches: Type complying with UL 917.

1. Contact Configuration: DPDT
2. Contact Rating: 20-A ballast load, 120/227V AC.
3. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
4. Astronomic time dial.
5. Eight-Day Program: Uniquely programmable for each weekday and holidays.
6. Skip-a-day mode.
7. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 8 hours.

2.3 OUTDOOR PHOTOELECTRIC SWITCHES

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

1. Area Lighting Research, Inc
2. Intermatic, Inc
3. Lithonia Lighting
4. TORK
5. Hubbell Automation
6. Watt Stopper

B. Description: Solid state, with DPST dry contacts rated for 1800-VA tungsten to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range.
2. Time Delay: 15-second minimum, to prevent false operation.
3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.

C. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.4 INDOOR OCCUPANCY/VACANCY SENSORS

A. It's the responsibility of the Electrical Contractor to ensure that sensors meet or exceed the specifications included herein. Sensors and their subcomponents shall operate as intended and under load conditions as shown within Contract documents.

1. Building Codes: All units shall comply with applicable, local building codes.
2. All sensors shall be FCC compliant where applicable.
3. Manufacturer shall 100% test all equipment prior to shipment. Sample testing is not acceptable.
4. UL listed having standard warranty of 5 years.
5. This contractor shall provide low voltage communication cable (type per manufacturer specification) from low voltage sensor to remote power pack or fixture per installation details. Cable shall be rated for plenum use.
6. Controls shall be recessed to limit tampering and provide user adjustable settings for time delay and sensitivity.
7. All office & classroom area will require occupancy sensor relay for connection to the HVAC. Refer to Lighting & mechanical drawings.

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

1. Watt Stopper – Basis of Design
2. Sensor Switch
3. Hubbell Building Automation
4. Cooper Controls

C. Submittals:

1. Bill of Materials: Complete list of all parts needed to fully install selected occupancy sensors.
    a. Product Data: Submit product data, including catalog cut sheets for specified products.
    b. Shop and Wiring Drawings: Submit shop drawings detailing all mechanical and electrical equipment including one-line diagrams, wire counts, coverage patterns, and physical dimensions of each item.
2. Documentation & Commissioning
    a. Field terminations shall be identified indicating wire originations. Point-to-point wiring diagram shall be provided and shall include "As-Built" conditions. Submit in duplicates to Owner and Project Architect.
    b. EC shall provide System Manufacturer on-site configuration and programming of lighting system. EC to provide training of Owners representative.
3.

a. Fixture Compatibility: List of ballasts and lamp combinations compatible with occupancy sensors, by manufacturer and catalog number.
b. Control cabling specifications.

D. Low Voltage Switch Requiremnents LVSW-103

1. The programming for the digital switch shall reside in the switch itself and shall communicate to system components via RS 485. Switches shall provide capabilities to be locally programmed. Each individual switch button being programmed for On only, Off only.
2. Switches installed shall be rated for high abuse areas and shall be vandal resistant, contain no moving parts, and be touch sensitive and available with up to three buttons in a single gang.

E. Switches must be capable of handling electrostatic discharges of at least 30,000 volts (1cmspark) without any interruption or failure in operation

F. Wall Switches:

1. Switch shall be rated at 120/277V in one unit with no minimum load requirements.
2. Walk through feature shall shut off lights within 2.5 minutes after momentary occupancy.
3. Automatically adapt to changing room conditions—with the ability to disable adaptive features.
4. Shall save learned and adjusted settings in non-volatile memory that retains all settings during power outages.
5. Maximum adapted time-out shall not exceed 30 minutes.
6. Switch sensor shall utilize PIR, ultrasonic or by combining both sensing technologies pending application of switch.
7. Dual operation: Automatic - on/off and manual on/off or automatic only operation.
8. Zero point switching.
9. Shall have a 3-position service switch: off, auto, and on when configured for dual operation or no switch for automation only operation.
    a. Single circuit
        1) Shall recognize motion detected within 20 seconds of turning off lighting as a false off. In response to a false off, the microprocessor shall increase the time-off setting.
        2) Rating: 1800W/VA @ 120V, 4000VA @ 277V, and 1/4HP @ 120VAC.
    b. Dual Circuit
        1) Shall provide switching for 2 separate banks from a single unit.
        2) Shall offer two modes of operation:
            a.) Only one relay responds to photocell.
        3) Both relays respond to photocell and lights return to the previous state on the next cycle.
        4) Ratings: Primary Relay - 800W @ 120V, 1200VA @120V, 2700VA @ 277V @ 120VAC; Secondary Relay - 800W @ 120V, 800VA @120V, 1200VA @ 277V.
10. Unless otherwise noted within contract documents, the Electrical Contractor shall provide wall occupancy switches with the minimum features:
    a. Dual sensor technology
    b. Single circuit
    c. Automatic and Manual operation
    d. Shall meet other requirements of project documents.

11. The Electrical Contractor, as part of the work of this section, shall coordinate, receive, mount, connect, and place into operation all occupancy related equipment. The Electrical Contractor shall furnish all conduit, wire, connectors, hardware, and other incidental items necessary for properly functioning lighting control and occupancy sensors as described herein and shown within contract documents. The Electrical Contractor shall maintain performance criteria stated by manufacturer without defects, damage, or failure.

G. Ceiling Vacancy Sensors

1. Shall use microprocessor for motion signal analysis and internal, adaptive self-adjustment. Shall automatically adapt to changing room conditions.
2. Shall identify, record and learn a room's normal occupancy cycles to automatically adjust the sensitivity threshold.
3. Shall save learned and adjusted settings in non-volatile memory that retains all settings during power outages.
4. Shall accept Class 2 wiring.
5. Shall mount on the ceiling.
6. Shall provide a concealed bypass switch to force on lighting.
7. Shall save learned and adjusted settings in non-volatile memory that retains all settings during power outages.
8. Shall be equipped with tamper resistant cover.
9. All controls shall be accessible from front of unit.
10. Rugged, plastic housing shall be available in white.
11. Shall incorporate a real-time motion indicator LED, which is visible from the front of unit.
12. Provide white ceiling mount occupancy sensors with accessories and required components as specified within Contract documents by one manufacturer. All color choices shall be confirmed with Architect.
    a. Dual Sensor
        1) Shall incorporate Doppler shift ultrasonic and passive infrared motion detection technologies.
        2) Shall be available in 360º coverage patterns. Infrared lenses shall have a 360º field of view.
        3) Sensor shall have two modes of operation:
            a) Multi-technology mode: where the sensors send infrared signal to the microprocessor, which makes the decision to turn on lighting based on the level of the signal.
            b) Single technology mode: where the user chooses technology that will turn on lighting.
        4) Shall have mask inserts for PIR rejection to prevent false tripping.
    b. Single Sensor - Ultrasonic
        1) Shall utilize Doppler shift ultrasonic detection technology.
    c. Single Sensor – PIR
        1) Shall utilize passive infrared motion detection.
        2) Shall automatically adapt to changing background PIR levels.
        3) Infrared lenses shall have 360º field of view.
        4) Shall have mask inserts for PIR rejection to prevent false tripping.
13. Wall Switch Sensors
    a. Provide a white wall mount occupancy switch by one manufacturer. All color choices shall be confirmed with Architect prior to ordering.
        1) Sensor Switch – Basis of Design

2) Hubbell
3) LC&D
4) Watt Stopper

b. Wall switch sensors shall recess into single-gang switch box and fit a standard GFI opening.
c. Wall switch sensors shall have optional features for photocell/daylight override, vandal resistant lens, and low temperature/high humidity operation.
d. Wall switch sensors shall be available in four standard colors (Ivory, White, Light Almond, Gray)
e. Wall switch sensors shall be the following Sensor Switch model numbers, with device color and optional features as specified:

nWSD (PIR, 1 Relay)

nWSD PDT (Dual Technology, 1 Relay)

nWSD 2P (PIR, 2 Relays)

nWSD PDT 2P (Dual Technology, 2 Relays)

nWSD NL (PIR w/ Night Light, 1 Relay)

nWSD PDT NL (Dual Technology w/ Night Light, 1 Relay)

nWSD LV (PIR, No Relay)

nWSD PDT LV (Dual Technology w/ Night Light, No Relay)

14. Line-Low Voltage Power Pack

a. Shall be compatible with incandescent, magnetic or electronic low voltage, and magnetic or electronic fluorescent, as well as motor loads.
b. Relay function shall not require more than 5-ma control current to operate.
c. Shall be installed inside a standard 4” x 4” junction box.
d. Ratings:

1) 20A incandescent, 20A fluorescent @ 120vAC, 20A fluorescent @ 277vAC
2) HVAC Relay – SPDT 500ma@24VDC three-wire isolated. Ratings: 0.5A, 125VAC; 1A, 30VD

15. The Electrical Contractor, as part of the work of this section, shall coordinate, receive, mount, connect, and place into operation all occupancy related equipment. The Electrical Contractor shall furnish all conduit, wire, connectors, hardware, and other incidental items necessary for properly functioning lighting control and occupancy sensors as described herein and shown within contract documents. The Electrical Contractor shall maintain performance criteria stated by manufacturer without defects, damage, or failure.

2.5 LIGHTING CONTACTORS

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

1. Allen-Bradley/Rockwell Automation
2. ASCO Power Technologies
3. Eaton Electrical Inc.; Cutler-Hammer Products
4. GE Industrial Systems; Total Lighting Control
5. Square D; Schneider Electric

B. Description: Mechanically held combination type 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 rated for area where installed.
4. Provide with control and pilot devices as indicated within Contract documents, matching the NEMA type specified for the enclosure.

2.6 EMERGENCY SHUNT RELAY (Where Applicable)

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

1. Lighting Control and Design, Inc., Lutron, Wattstopper, LC&D or approved equal.

B. Description: Lighting Control and Design Model GR 2001 E/S emergency shunt trip relay wired in parallel with light switch to shunt on manually controlled emergency lighting during a power outage. Relay shall be ETL listed for use on emergency lighting systems, UL 924. Coil rating as noted within Contract documents.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 95 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions. Provide back boxes, mounting brackets, guards, trims plates or other required finishes to provide a complete and functional unit.

The locations and quantities of sensors indicated within Contract drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the intended area while meeting 95 percent coverage. It is this contractor’s responsibility to arrange a pre-purchase/installation meeting with the manufacturer’s factory authorized representative, at the owner’s facility, to verify placement of sensors and installation criteria.

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 "Wire & 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. Cable type, pair quantity or sizing of conductors according to lighting control 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.

E. It is this contractor's responsibility to insure exposed cables are properly bundled, supported, protected and rated (plenum) for area of installation.

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.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices which fail tests and inspections are considered defective work and shall be replaced at no cost to the project.

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.

3.7 DEMONSTRATION

A. 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." Provide no less than (3) three complete set of operation and maintenance manuals at time of training.

END OF SECTION 260923

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SECTION 262200 LOW-VOLTAGE TRANSFORMER

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE

A. Dry type energy efficient transformers shall be provided in the distribution system. Transformers shall have kVA and voltage ratings as indicated on the Contract Documents. Transformers 15kVA through 750kVA shall meet HIGH efficiency requirements of NEMA Premium Mark Transformers.

B. Distribution transformers for non-linear three-phase loads shall be of the harmonic mitigating type having minimum K-7 rating.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code (Latest Edition)

B. NEMA ST20 - Dry-Type Transformers for General Applications

C. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment

D. NEMA TP1 - Energy Efficiency for Distribution Transformers

E. NEMA TP2 - Standard Test Method for Measuring the Energy Consumption of Distribution Transformers

F. NEMA TP3 2000 - Defines the labeling of distribution transformers tested to the efficiency levels specified in TP 1.

G. UL 1561 - Dry-Type General Purpose and Power Transformers

1.4 SUBMITTALS FOR REVIEW

A. Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

1.5 SUBMITTALS FOR INFORMATION

A. Test Reports: Indicate loss data, efficiency at 25, 50, 75, and 100% rated load, and sound level.

B. Submit manufacturer’s installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include

instructions for storage, handling, protection, examination, preparation, and installation of product.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section shall have a minimum of ten (10) years of experience.

B. Manufactured in a certified ISO 9001 facility.

1.7 REGULATORY REQUIREMENTS

A. Installation to conform to requirements of NFPA 70 and all local codes and standards.

B. Products: Listed and classified by Underwriters Laboratories, Inc. or Inspection Bureau, Inc. as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components enclosure, and finish.

PART 2 - PRODUCTS

2.1 BASIC REQUIREMENTS

A. Sound levels must be 5% below NEMA standard levels according to kVA size.

B. All insulating materials are to exceed NEMA ST20 standards and be rated for 220°C UL recognized insulation system.

C. Transformers shall be configured with maximum winding temperature rise of 80degC.

D. Transformer shall have the following minimum full capacity taps: two (2) 2-1/2% taps above and four (4) 2-1/2% taps below normal rated primary voltage.

E. Neutral: Neutrals sized to accept 200% rated neutral conductors.

F. General purpose shall be low loss type meeting efficiencies per NEMA TP-1, as tested per NEMA TP-2.

G. NEMA Premium Mark labeled transformers shall minimally comply with the following when tested per NEMA TP-2:

H. Enclosure:

1. The transformer shall be protected by a ventilated heavy gauge metal enclosure with ventilating openings. The enclosure shall be degreased, cleaned, primed and finished with baked enamel coating.
2. The transformer core and coil shall be mounted on vibration isolator pads.

I. Basic Impulse Level shall be 10 kV.

J. Enclosure: Type 1 ventilated. Provide lifting eyes and brackets. Provide NEMA 3R for installations subject to overhead moisture or installed in suitable environment.

K. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

L. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

M. Transformer shall be suitable for floor mounting unless noted otherwise.

N. Isolate core and coil from enclosure using vibration-absorbing mounts.

O. Transformer coils shall be copper or aluminum windings of the continuous wound construction type and shall be impregnated with non-hygroscopic, thermosetting varnish.

P. Harmonic Mitigating (where called for):

1. Shall supply phase shift of -15°, 0°, 30° or otherwise noted on contract documents. Minimum K-7 rating.
2. Have an impedance range of 3%-5% with a minimum reactance of 2% to aid in reduction of neutral currents.
3. Electrostatic shielding to be provided the attenuation of line noise and transients shall equal or exceed the following limits:

    a. Common Mode: 0 to 1.5kHZ - 120dB; 1.5kHZ to 10kHZ - 90dB; 10kHZ to 100kHZ - 65dB; 100kHZ to 1MHZ - 40dB
    b. Transverse Mode: 1.5kHZ to 10kHZ - 52dB; 10kHZ to 100kHZ - 30dB; 100kHZ to 1MHZ - 30dB.

2.2 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one (1) of the manufacturers specified per models listed or as recommended by manufacturer representative per given application:

1. Square D

2.3 PROJECT REQUIREMENTS

A. Primary Voltage: 480 volts unless noted otherwise.

B. Secondary Voltage: 208/120 volts 4 wire unless noted otherwise.

C. Phasing: 3-phase and/or single phase unless noted otherwise.

D. Provide transformer equipment pad for each floor mounted unit as specified within contract documents.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Transformers shall be securely mounted level and plumb, from the building structure or walls with mass at locations shown on Contract documents. Use a neoprene compressive material at points of mounting to cut vibration noises. Sizing of vibration isolators in accordance with actual weight of installed unit. In general, transformers shall be located, set, mounted and connected in such a manner to keep noise levels within the surrounding ambient noise levels.

B. Provide structural steel angle knee bracing platform to mount transformers on walls or provide angles welded to building structural steel members with rods dropping to angle or channel steel platform necessary to support transformers hung above ceiling. Furnish prime coats of paint on steel. Transformer steel supports shall be designed to adequately carry the load imposed and in no case shall supports be anchored to building steel where imposed loads shall endanger building structural system. Verify structural integrity of area where transformers are to be located. Locate transformers in area to assure adequate air circulation around unit. Coordinate hung transformer weight with General Contractor for approval.

C. Unit shall be mounted on free standing rubber vibration isolators sized in accordance with actual weight of unit installed.

D. Use flexible conduit, 24" minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

E. A minimum of 2" space shall be allowed around all ventilation openings or in accordance with manufacturer's recommendations.

F. Provide grounding bonding and required lugs.

G. Accessories: All related items required for connection and final installation shall be provided by this contractor including lugs, wire, crimps, lifting apparatus, tape, shields etc.

H. Mounting location must remain accessible for inspections, replacement and general service.

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.2.

3.3 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION 262200

SECTION 262416 BRANCH CIRCUIT PANELS

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. Lighting and appliance branch-circuit panelboards.

2. Transient voltage suppression panelboards.

B. Provide electric service with capacity and voltage requirements as shown on the drawings.

C. Interrupting Capacities: Panel boards to have interrupting capacity capable of handling fault current which is available at the point in the circuit where the panel is installed.

D. Interrupting ratings are listed in the panel schedules on the drawings. These capacities are based on feeder sizes and panel locations shown on drawings. If changes are made, these ratings must be adjusted by the Electrical Contractor.

E. Source Limitations: Obtain switchgear, panelboards, overcurrent protective devices, components and accessories through one source from a single manufacturer.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. RFI: Radio-frequency interference.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, transient voltage suppression device, accessories, and components indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details for types other than NEMA 250, Type 1.

b. Bus configuration, current, and voltage ratings.

c. Short-circuit current rating of panelboards and overcurrent protective devices.

d. Retain first subparagraph below if series rating of overcurrent protective devices is used.

e. UL listing for series rating of installed devices.

f. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Power, signal, and control wiring.

C. Panelboard Schedules: For installation in panelboards.

D. Operation and Maintenance Data: For panelboards and components 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 overcurrent protective devices.

2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

3. Selective coordination and series rating charts.

1.5 QUALITY ASSURANCE

A. If an independent testing agency is required, see Division 01 Section "Quality Requirements" for general testing and inspecting agency qualification requirements. If additional control is needed, use one of first two paragraphs below to specify 29 CFR 1910.7 or other more specific criteria (e.g., NETA). 29 CFR 1910.7 defines a nationally recognized testing laboratory as it applies to testing and inspecting for safety, and lists, labels, or accepts equipment and materials that meet certain OSHA criteria.

B. 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.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: 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’s representative no fewer than 2 days in advance of proposed interruption of electrical service.

a. Do not proceed with interruption of electrical service without written permission.

1.7 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

B. Coordinate size and location of Electric Contractor concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 EXTRA MATERIALS

A. Provide panelboard nameplate per “Electrical Identification” specification 26-05-53.

B. 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. Keys: (6) six spares for each type of panelboard lock.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:

a. Cutler-Hammer

b. Square D

c. General Electric

2.2 SHORT-CIRCUIT RATING

A. UL label indicating series-connected rating with integral or remote upstream overcurrent protective devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.

B. Equipment shall be fully rated to interrupt symmetrical short-circuit current available at terminals as noted on drawings or otherwise scheduled.

2.3 GROUND FAULT PROTECTION

A. The ground fault and overload trip mechanisms shall be of the static type with adjustable, long-time, short-time, and instantaneous both in time and current setting. Ground fault protective circuitry hall be provided in accordance with NEC requirements. Settings of protective device shall be provided by this contractor or its representative.

B. Provide ground fault protection for service as shown on contractor documents.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Lighting and appliance panelboards shall be of construction by Square D Type NQOD or NF or an approved manufacturer, 3 phase, 4 wire, voltage as specified on drawings, in which:

B. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

C. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

D. Bus: Copper bus bars of capacity sufficient to carry intended and future loads as called for within drawings. Include grounding, neutral and associated ampere rated lugs.

2.5 PANELBOARD ACCESSORIES

A. Accessories: Provide all required accessories required for a complete assembly and as noted on drawings or otherwise scheduled but not limited to the following: lug kits, ground and neutral bars, filler plates, breakers, TVSS, shunt trip devices, breaker handle attachments, circuit ID strips, completed directory card, etc.

2.6 TRANSIENT VOLTAGE SURGE SUPPRESSION

A. See specification 26 43 10 “Transient Voltage Surge Suppression”

2.7 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.

1. Provide overload protection for each devices or circuits deriving from panels according to plans or schedules. Where specific circuit has not been assigned to a device or equipment, a properly sized circuit for load served shall be provide at no additional cost to the project.

2. 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.

3. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

4. Electronic trip-unit circuit breakers shall have RMS sensing; field-replaceable rating plug; and with the following field-adjustable settings:

a. Instantaneous trip.

b. Long- and short-time pickup levels.

c. Long- and short-time time adjustments.

d. Ground-fault pickup level, time delay, and I^2t response.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.

2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment;

3. Shunt Trip: Panels in areas where shown on plans shall be equipped with breakers featuring shunt trip coils operating as120vAC. Coil shall be energized from separate circuit, set to trip at 75 percent of rated voltage unless specified elsewhere or subject to code compliance.

4. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.

5. Auxiliary Contacts: One SPDT switch with "a" contacts mimic circuit-breaker contacts.

6. Multipole units enclosed in a single housing or factory-assembled to operate as a single unit.

C. Branch Breakers

1. Branch circuit portions of each panel board shall comprise the required and indicated number of interchangeable bolt on non combustible thermal magnetic circuit breaker sections; single or multiple pole, rated not less than 20 amperes, 125 volts and higher as noted. Breakers are required to provide I.C. sym. amp as shown on the panel schedule(s).

2. Circuit breakers shall be readily removable from the front of panel board without disturbing adjacent units. They shall have quick make and quick break toggle mechanisms, non fusible contacts, with inverse time, short circuit characteristics. Breakers shall trip free on overload. They shall indicate clearly whether they are in the open, tripped or closed position. Multipolar units shall have thermal element in each pole and shall have a single handle. Closely grouped circuit breakers and thermal tripping devices mounted in a common cabinet shall be de rated when necessary in accordance with NEMA standard recommended practices for high ambient temperatures.

3. Circuit breakers protecting circuits supplying receptacles, signaling devices, clocks, special equipment and other similar circuits not requiring switch control shall be equipped with an approved breaker locking device as shown on panel schedules.

4. Panelboards shall be provided with integral TVSS where shown on drawings or panel schedules.

5. Breakers in panelboards used for switching of circuits shall be rated for switching duty.

6. Breakers loads which include high intensity discharge (HID) lighting systems, such as mercury vapor, metal halide or high-pressure sodium shall be HID rated.

7. Lighting applications or other applications where high inrush current exceeds standard tripping conditions, high-magnetic circuit breakers shall be used. Consult branch breaker manufacturer for applications requiring such.

8. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator. Single- and two-pole configurations with **5**-mA trip sensitivity. Provide 30-mA trip sensitivity for electric heating equipment conforming to the NEC. EC shall ensure branch circuit length for GFCI circuits do not exceed manufactures recommended load distance to prevent nuisances tripping.

D. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

E. Fuses are specified in Division 26 Section "Fuses."

2.8 ACCESSORY COMPONENTS AND FEATURES

A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Furnish portable test set to test functions of solid-state trip devices without removal from panelboard.

C. Fungus Proofing: Permanent fungicidal treatment for panelboard interior, including overcurrent protective devices and other components.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1. Mounting shall be plumb and rigid without distortion of box.

B. Surface mounted panelboards shall be mounted on a 3/4" thick, painted plywood mounting board. Plywood shall be fire retardant via painted surface using listed coatings.

C. Panelboards mounted on perimeter outside walls to be shimmed 1/2" from wall with washers to permit back ventilation.

D. Mount top of panelboard cabinets 72 inches above finished floor, unless otherwise indicated.

E. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

F. Install overcurrent protective devices and controllers.

1. Set field-adjustable switches and circuit-breaker trip ranges.

G. Install filler plates in unused spaces.

H. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

I. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads. Use a computer create directory; handwritten directories are not acceptable. Issue final panelboard, switchboard or other distribution equipment load schedules in an Owner compatible spread sheet format. Hard copies of finalized load schedules shall be placed in corresponding directory pouch.

C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables.

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. 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.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.

2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.

3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.

4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.5 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements, Division 1 Specifications, apply to this Section.

1.2 DESCRIPTION

A. This section covers power-related devices such as receptacles, switches, and plug strips.

B. Devices listed in this section may or may not be used on this project. Specifications for devices not included in the Contract Documents are included in case they are needed during construction phase.

1.3 LOCATION OF DEVICES

A. The approximate schematic location of devices is given within Contract documents. The exact location shall be determined at the building as the work progresses. Refer to Architectural plans for any special details, elevations, and reflective ceiling plan. Verify door swings at job site. In no case shall switches be located behind door swings. Any switch so located shall be changed. Field verify equipment location and adjust locations to avoid inaccessibility. Relocate inaccessible outlets.

B. This contractor shall be responsible for installations of wiring devices meeting ADA requirements where applicable.

C. Unless otherwise indicated or otherwise decided at the site or required to meet ADA requirements, outlet boxes in walls shall be located with centerline at elevation above the finished floor as noted below:

D.

Fire Alarm Telephone	4 feet 9 inches (unless directed by AHJ)
Fire Alarm Notification	6 feet 8 inches or 6 inches below ceiling in low ceiling areas
Fire Alarm Pull Stations	3 feet 6 inches (to activation handle)
Fire Alarm Speaker	Ceiling mounted or 8 feet or 6 inches below ceiling in low-ceiling (wall mounted) areas
Fire Alarm Annunciator	5 feet 2 inches (unless directed by AHJ)
Fire Alarm Control Panel	6 feet (to top of panel)
Wall Switch Outlets	4 feet 0 inches
Convenience Outlets (general)	1 foot 6 inches
Convenience Outlets (mechanical areas)	4 foot 0 inches
Counter Outlets	8 inches above countertop
Desk Telephone Outlets	1 foot 6 inches
Wall Telephone Outlets	5 feet 0 inches
Telephone Outlets above Counter	8 inches above countertop
Thermostat	4 feet 4 inches
Public Telephone Outlets	Coordinate with telephone company
Plug In Strip	To be determined at the site
Exterior and Interior Wall Brackets	To be determined at the site

1. The Architect and Owner's representative reserve the right to change the location of any outlet, before it has been installed.

1.4 DESCRIPTION

A. Wiring Device Requirements

1. Use the products of a single manufacturer for each type of wiring device.
2. Receptacles for general equipment or Owner's-Furnished Equipment: match cord-plug configurations.
3. Use the products of a single manufacturer of all wiring and device plates. Obtain prior approval for any variations from this requirement, except that plate variations are allowed for the following devices:

a. Where the selected plate manufacturer does not manufacture a suitable finish plate.
b. For heavy-duty receptacles rated at more than 30 amperes.
c. Where the raceway system enclosure employs a non-standard finish plate.
d. Where non-standard plates are specified or indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Representative general purpose wiring devices and device plates as listed herein are intended to indicate type, function, and quality of the products. Provide the products as specified.

1. Industrial/Institutional construction type:

a. Receptacles, toggle and snap switches: Hubbell, Pass & Seymour, Leviton, Cooper Wiring Devices
b. Lighting Control; Dimmers & Occupancy Sensors: Hubbell, Leviton, Wattstopper, Lithonia, Cooper Wiring Devices
c. Time Switches: Intermatic Inc., Tork, MH Rhodes
d. Exterior/Cast: Crouse-Hinds, Appleton, Hubbell, Cooper Wiring Devices

2. Hospital Grade:

a. Tamper-resistant duplex receptacles. Manufacturer as named.

2.2 STANDARDS

A. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G and UL 498.

B. GFCI Receptacles: Straight blade, non-feed-through type, with integral NEMA WD 6, complying with UL 498 and UL 943-2003. Design units for installation in a 2-3/4" deep outlet box without an adapter.

C. Pendant Cord/Connector devices shall have matching, locking-type plug and receptacle body connector, NEMA WD 6, Configurations L5-20P and L5-20R, Heavy-Duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

D. Single- and Double-Pole Switches: Comply with DSCC W-C896F and UL 20.

E. Wiring device color unless specifically noted within contract documents. All color choices shall be confirmed with Architect:

1. White within finished areas
2. Ivory mounted in surface mounted raceways
3. Black within equipment rooms (electrical, mechanical, technology closets)
4. Red fed from emergency/standby power circuits
5. Yellow for exterior weather resistant duplex receptacles

2.3 SWITCHES

A. General:

1. Device (general use) color: White within finished areas, White for lighting controls within finished areas, Ivory mounted in surface mounted raceways or black within unfinished areas. All color choices shall be confirmed with Architect.
2. Switches mounted vertically shall have the "ON" position at the top and horizontal-mounted switches shall have the "ON" position at the left. Unless otherwise indicated switches shall be mounted in the vertical position.
3. Tumbler switches shall be the AC heavy-duty, specification grade, 120/277 volts, flush toggle type switch rated at 20 amperes, Underwriters' approved and meeting NEMA Standard WD-1 1965 and Federal Specifications W-S-896d (Type III). The operating mechanism shall be totally enclosed in a high-heat, non-inflammable, non-hygroscopic molded compound case with terminal screws located on the side of the switch. Operating handles shall be made of high heat phenolic compound. Switches shall have wide plaster ears.
4. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switch and audible frequency and EMI/RFI filters. Architectural grade, preset slide control, plate kit, AC dimmer with minimal wattage (after derating) and specified voltage for intended load. Contractor provided dimmer shall be compatible with fluorescent ballast manufacturer.

    a. 120v Hubbell AS-103, AS-153, AS-203 (White) P&S, Leviton
    b. 277v Pass & Seymor 93271, 93472, 93673, 93874 (White) – Magnetic, Hubbell, P&S
    c. 277v Leviton MNX20-7L, MNX30-7L (White) – Electronic, Hubbell, P&S.

B. Occupancy Sensors:

1. See specification 260923 “Lighting and Control Devices”.

C. Manufacturers:

1. Single pole toggle switch, 20 ampere, 120-277 volt, institutional grade, Hubbell Catalog No. HBL1221, Pass & Seymour, Cooper Wiring Devices or Leviton equal.
2. Keyed single pole toggle switch, 20 ampere, 120-277 volt, industrial-institutional grade, Hubbell Catalog No. HBL1557L, Pass & Seymour, Cooper Wiring Devices or Leviton equal.
3. Three-way toggle switch, 20 ampere, 120-277 volt, institutional grade, Hubbell Catalog No. HBL1223, Pass & Seymour, Cooper Wiring Devices or Leviton equal.
4. Four-way toggle switch, 20 ampere, 120-277 volt, institutional grade, Hubbell Catalog No. HBL1224, Pass & Seymour, Cooper Wiring Devices or Leviton equal.
5. Double pole toggle switch, 20 ampere, 120-277 volt, institutional grade, Hubbell Catalog No. HBL1222, Pass & Seymour, Cooper Wiring Devices or Leviton equal.
6. Single pole key lock switch, 20 ampere, 120-277 volt, institutional grade, Hubbell Catalog No. HBL1221-L, Pass & Seymour, Cooper Wiring Devices or Leviton equal.

7. Single pole toggle switch with pilot light on with load off, 20 ampere, 120 volt, institutional grade, Hubbell Catalog No. HBL1221-PL, Pass & Seymour, Cooper Wiring Devices or Leviton equal.
8. Three-way toggle switch with pilot light on with load off, 20 ampere, 120-277 volt, institutional grade, Hubbell Catalog No. HBL1223-IL, Pass & Seymour, Cooper Wiring Devices or Leviton equal.
9. Momentary contact switch, 3-position, 2-circuit, center off, 20 ampere, 120-277 volts, institutional grade, Hubbell Catalog No. HBL1557.
10. Maintained contact switch, 3-posistion, 2-circuit, center off, 20 ampere, 120-277 volts, institutional grade, Hubbell Catalog No. HBL1385.
11. Fan switches — coordinate with fan supplier (switch is normally provided by fan supplier; if not, provide single-pole switch listed above or provide manual motor starter per specification 262913 where motor overload protection is not provided).

C. Miscellaneous Switch Appurtenances:

1. Weatherproof cover - Hubbell 1795
2. Locking cover - Hubbell 96061
3. Pass & Seymour, Leviton equal.

2.4 CONVENIENCE RECEPTACLES

A. Receptacles for convenience outlets shall be duplex self-aligning grounding type rated for 20 amperes at 125 volts. Contacts shall be made of heavy spring copper or bronze so designed as to securely grip both sides of each receptacle blade and shall be enclosed in high heat, non-inflammable, non-hygroscopic molded compound case, provided with wide plaster ears. Each terminal shall be provided with two (2) binding screws located on the side of the receptacle. Hubbell Catalog No, IG5362GY, Pass & Seymour, Cooper Wiring Devices or Leviton equal.

B. Where noted within Contract documents, tamper-resistant convenience outlets shall be rated for 20 amperes at 125 volts with integral shutter or reciprocating contact system meeting minimum requirements as noted above. Nylon face shall visually identify unit as tamper resistant; Hubbell Catalog No, HBL8300SGGYA, Pass & Seymour, Cooper Wiring Devices or Leviton equal.

C. USB Receptacles: Where noted within Contract documents, tamper-resistant convenience outlet shall be Decora type, rated for 20 amperes at 125 volts with integral shutter or reciprocating contact system containing (2) high powered 5vDC 3.6A USB 2.0 Type A integral charging ports. Leviton T5832, Hubbell, Pass & Seymour or Copper equal.

D. Manufacturers:

1. Generator fed receptacle (derived from “E” or “S” type panels), 20 ampere, 125 volt, 2 pole, 3 wire grounding type, NEMA 5-20R, red in color and connected to the normal/emergency/standby system; Hubbell Catalog No. HBL5362R, Pass & Seymour, Cooper Wiring Devices or Leviton equal. The stainless steel cover plate shall have the word "Generator" engraved at the top with red filled lettering.
2. Ground fault interrupter type duplex receptacle, 20 ampere, 125 volt, 2 pole, 3 wire grounding type, NEMA 5-20R; Hubbell Catalog No. GFR5352-__ST, Pass & Seymour, Cooper Wiring Devices or Leviton equal.
3. Safety type duplex receptacle, 20 ampere, 125 volt, 2 pole, 3 wire grounding type, NEMA 5-20R. Pass & Seymour Catalog No. SG-62
4. Duplex receptacles fed from computer panelboards shall be of color white, 20 ampere, 125 volt, 2 pole, 3 wire grounding type, NEMA 5-20R, Hubbell Catalog No. 5362OW (white), Pass & Seymour, Cooper Wiring Devices or Leviton equal.
5. Single receptacle, 20 ampere, 125 volt, 2 pole, 3 wire grounding type, NEMA 5-20R ("EWC" denotes electric water cooler-coordinate mounting height with the equipment

supplier); Hubbell Catalog No. 5361-BK, Pass & Seymour, Cooper Wiring Devices or Leviton equal.

6. Exterior duplex receptacles shall be yellow in color weather resistant type. Leviton WBR20-Y, Pass & Seymour or Hubbell equal.

E. Appurtenances:

1. Weatherproof covers - use Hubbell WP26 or WPSF26, Pass & Seymour Catalog No. WPH8 or Bryant Catalog No. 4510D for GFI-WP locations; or Hubbell 5205WO or 5206WO, Pass & Seymour Catalog No. WPH26 for non-GFI-WP locations. Leviton equal.

2.5 PROTECTED RECEPTACLES

A. Receptacles shall be ground fault and/or arc-fault protected in accordance to Articles 210.8 and 210.12 of 2011 National Electric Code.

2.6 SPECIAL PURPOSE RECEPTACLES

A. Special purpose receptacle, size and type as called for within Contract documents. (Each receptacle shall be provided with one matching plug for installation on the associated piece of equipment.)

B. 30 ampere, 125 volt, 1 phase, 2 pole, 3 wire grounding type, single receptacle, with black face, NEMA 5-30R. Hubbell Catalog No. 9308. (Plug-Catalog No. 9309), Pass & Seymour, Cooper Wiring Devices or Leviton equal.

C. 20 ampere, 250 volt, 1 phase, 2 pole, 3 wire grounding type, single receptacle, with brown face, NEMA 6-20R. Hubbell Catalog No. 5461. (Plug-Catalog No., 5466-CA), Pass & Seymour, Cooper Wiring Devices or Leviton equal.

D. 30 ampere, 250 volt, 1 phase, 2 pole, 3 wire grounding type, single receptacle, with black face, NEMA 6-30R. Hubbell Catalog No. 9330. (Plug-Catalog No. 9331), Pass & Seymour, Cooper Wiring Devices or Leviton equal.

E. 50 ampere, 250 volt, 1 phase, 2 pole, 3 wire ground type, single receptacle, with black face, NEMA 6-50R. Hubbell Catalog No. 9650. (Plug-Catalog No. 9650-ANP), Pass & Seymour, Cooper Wiring Devices or Leviton equal.

F. 50 ampere, 125/250 volt, 1 phase, 3 pole, 4 wire grounding type, single receptacle with black face NEMA 14-50R. Hubbell Catalog no. 9450-FR. (Plug Catalog No. 9452- ANP), Pass & Seymour, Cooper Wiring Devices or Leviton equal.

G. 20 ampere, 250 volt, 1 phase, 2 pole, 3 wire grounding type, single twist, single twist-lock receptacle, with black face, NEMA L6-20R. Hubbell Catalog No. 2320. (Plug-Catalog No. 2321-CA), Pass & Seymour, Cooper Wiring Devices or Leviton equal.

H. 30 ampere, 250 volt, 1 phase, 2 pole, 3 wire grounding type, single twist-lock receptacle, with black face, NEMA L6-30R. Hubbell Catalog No. 2620. (Plug-Catalog No. 2621-CA), Pass & Seymour, Cooper Wiring Devices or Leviton equal.

I. 50 ampere, 125/250 volt, 1 phase, 3 pole, 4 wire grounding type, single twist-lock receptacle, with black face, NEMA L6-50R. Hubbell Catalog No. CS6369. Hubbell Catalog No. 6365, Pass & Seymour, Cooper Wiring Devices or Leviton equal.

J. 30 ampere, 125/250 volt, 1 phase, 3 pole, 4 wire grounding type, single twist-lock receptacle, with black face, NEMA L14-30R. Hubbell Catalog No. 2710. (Plug-Catalog No. 2711-CA), Pass & Seymour, Cooper Wiring Devices or Leviton equal.

K. 50 ampere, 125/250 volt, 1 phase, 3 pole, 4 wire grounding type, single receptacle with black face NEMA 14-50R. Hubbell Catalog No. 9450-FR. (Plug Catalog No. 9452-ANP), Pass & Seymour, Cooper Wiring Devices or Leviton equal.

L. 20 ampere, 250 volt, 3 phase, 3 pole, 4 wire grounding type, single twist-lock receptacle, with black face, NEMA L15-20R. Hubbell Catalog No. 2420. (Plug-Catalog No. 2421), Pass & Seymour, Cooper Wiring Devices or Leviton equal.

2.7 COVER PLATES

A. Unless otherwise specified, switch, receptacles, special purpose outlets, wall mount telephone, and other device plates shall be Bureau of Standards No. 302-18.8 brushed or satin stainless steel with beveled edges so as to lie flat against the wall. Where more than one (1) switch or receptacle occurs at one point, use a single multi-gang plate.

B. Zinc-coated plates may be used in unfinished spaces.

C. Plates shall be set true and plumb and shall fit tight against finished wall surfaces and outlet boxes.

1. Manufacturers: Hubbell 97000 Series, Pass & Seymour, Cooper Wiring Devices or Leviton equal.

2.8 FLOOR BOXES

A. Floor boxes are flush floor mounted of type noted at locations shown on plans or otherwise scheduled.

B. Floor boxes shall be of proper type as called for and sized as required by the NEC and shall be secured firmly in place and set true and flush with the final finished floor surface.

C. Floor boxes shall be fully fitted with required number of receptacles, modular communication connectors (phone, data, video, audio etc), separators, partitions, plates, sub plates, trim rings, metal covers and other necessary items required for a complete assembly. Other specifications requirements by particular manufacturer.

1. Characteristics: Complete factory assembled unit consisting of floor fittings, cover assembly, application plates and suitable for both on or above grade applications. Assembled unit having a UL listed 514A and 514C for scrub water requirements. Final cover plate shall match final floor finish or as noted on architectural documents. Where required, assembly shall have UL listing for use in fire rated floors. Floor boxes are rated and acceptable for use in environmental air handling spaces per NEC article 300.22(C). Separate raceways and sections for power and communications with minimum power size of 3/4" and 1” for communications.
2. Sub-plate: Provide a complete fully fitted plate meeting minimum requirements as shown within Contract documents. Furnished sub-plate shall include receptacles, data, video, audio or furniture feeds as required.

D. Manufacturer:

1. Hubbell : S1CFB cast box, S1CFCBRS or S1TFCBRS brass cover, S1SP4X4 or other sub-plate configuration to met project requirements.
2. Hubbell: B2437 or B4214 cast box, brass screw cover plate for tile or terrazzo floors such as but not limited to: S3625, S2825 or S3425.
3. Manufacture and model as called for within Contract Documents. Include required plates, sections, faceplates, terminations including specified construction.
4. Approved equal from Leviton or Pass & Seymor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Devices shall be flush mounted unless otherwise noted. Properly align level and plumb devices including plates. Plates shall fit flat against wall and tight against device surface without straining or buckling the plate.

B. Devices to be recessed mounted flush and level in CMU (Concrete Masonry Unit) walls in all areas except mechanical and electrical rooms. Devices shall be installed in a neat and workmanlike manner. Holes for device boxes shall be saw-cut and uniform. Cuts shall be plumb and level, with minimal space around perimeter of boxes that will require grout. Boxes shall be grouted in place.

C. 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.

D. Code sized (#12 minimum) bonding jumper shall connect grounded outlet box to receptacle grounding terminal on flush-mounted units.

E. Where receptacles are indicated as split-wired and half of the receptacle is on a wall switch, the top receptacle shall be switched and bottom shall be on normal power.

F. Switches mounted vertically shall have the "ON" position at the top.

G. Receptacles shall be mounted in the vertical position with the ground terminal on bottom.

H. Install wall dimmers achieving minimum wattage of connected load including sufficient capacity after de-rating for ganging according to manufacturer's written instructions. Sufficient clearances shall be maintained where dimmers are ganged. Provided dimmers controlling fluorescent ballasts shall be compatible.

I. Devices installed in areas for use by physically disabled persons, such devices shall be mounted in accordance to Americans Disabilities Act. Refer to architectural drawings, Architect or on-site representative for ADA designated areas.

J. Wiring devices shall have power feed wiring labeled within device box with circuit and panelboard source.

3.2 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports when requested.

1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

B. Remove malfunctioning units, replace with new units and retest as specified above.

END OF SECTION 262726

SECTION 26 27 30 - TAPS, SPLICES & TERMINATIONS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, General Requirements, Division 1 Specifications, apply to this Section.

1.2 DESCRIPTION

A. Provide taps, splices and termination devices approved and sized for copper cables at voltage and current rating matching characteristics of terminating conductor.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Conductors splices in No. 10 AWG and smaller wire to be made with Minnesota Mining Manufacturing Co. insulated "Scotch Locks", Ideal Co. "Wing Nut", T. & B "Piggy" connectors, or with mechanically crimped sleeves as manufactured by T & B or Ideal Company, which shall be insulated with pressure sensitive electrical tape equal to Scotch No. "33+" or No. 88. Splicing components shall be rated for copper and aluminum conductors.

B. Conductors #8 AWG and larger shall be terminated, spliced, and tapped with Thomas & Betts color-keyed compression connector’s series 54000 or equal. The manufacturers recommended tools and dies shall be used.

C. Copper cable lug connections #8 and larger to copper bus bar mains and branches shall use copper solderless connectors having either 2-bolt cast copper clamps or compression connectors, Thomas & Betts Series 54000 with manufacturer's recommended hexagonal dies and hydraulic compression tools.

D. 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.

E. Connections to equipment shall be made with pressure type terminals. Stranded wire shall use spade type terminals or terminal approved for use. Connections shall contain one conductor unless otherwise rated for multiple conductors.

2.2 MANUFACTURERS

A. 3-M, O.Z., Thomas & Betts or approved equal.

2.3 WIRE LABELS

A. Each cable or wire termination shall be identified as noted on drawings, schedules or where not indicated, label shall note applicable branch circuit, phase and/or connected equipment. Labels

shall be pressure sensitive or clip on PVC type. Approved Manufacturers: Brady, 3M or approved equal.

2.4 TERMINAL BLOCKS

A. Where terminal blocks/strips are indicated or otherwise required, provide a complete assembly of blocks/strips having each terminal equipped with two clamp type pressure lugs or two washer bead binding screws. Use terminal strips with voltage and ampere rating sufficient to carry intended loads. Provide a white marking strip along the center line of each row of terminal for identification. Use strips having plastic barriers between adjacent terminals. Provide indicated terminal quantities or otherwise required. If quantity is not indicated, provide one terminal for each conductor entering enclosure plus 20 percent spare terminals. Type or otherwise mark the identification strip to identify each connected circuit. Relate identification to wiring diagrams, panel schedules and other terminals in a logical manner, where specific identification requirements are not indicated. Under no circumstances shall more than one wire be terminated under each terminal unless rated otherwise. Use only approved type jumper to mechanically connect terminals to each other.

1. Approved Manufacturer: Allen Bradley, Ilsco, Marathon or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Make taps, splices, and terminations at junction boxes, pull boxes, switches, panel boards, and any other electrical equipment, etc. Wires shall be continuous between outlet to outlet, or from panel board to the first outlet, etc.

B. Backboxes, device boxes, fittings or junction boxes shall be suitably sized permitting adequate conductor fill capacity per Article 314 of the National Electrical Code.

C. All taps and splices shall be fully insulated meeting minimum insulating values of wire or conductors used.

D. After splices are mechanically secure, provide listed electrical tape to insulate splice to equal the original insulation voltage rating of the wires, or utilize Thomas & Betts heat shrinkable insulators Series H.S. If the type of connector installed provides equivalent insulation, taping may be omitted.

E. EC shall provide and install all feeders and branch circuit wiring to all disconnect switches, equipment, controllers, motors and wiring devices. Terminations shall be in full compliance with project documents and meet the installation requirements of the manufacturer.

END OF SECTION 262730

SECTION 262813 - FUSES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION

A. Provide fuses in accordance with the contract documents in motor starters, switchgear assemblies, panel boards, disconnect switches, control devices, lighting fixtures or other required components or equipment.

B. Fuses shall be provided and installed in equipment being furnished by the respective contractor.

C. This Section includes: Cartridge fuses rated 600 V and less for use in equipment or components as specified or noted within contract documents.

D. Provide a complete set of three (3) spare fuses for each fuse size and type used.

E. All fuses provided shall be of the indicating type, employing either an indicating window or a mechanical indicator striker pin where available.

F. Where ambient temperature to which fuses are directly exposed is less than 40 degF or more than 100 degF, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

G. Fuses shall be current limiting with 200,000 ampere interrupting capacity and UL labeled or as specified by manufacturer.

H. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Obtain fuses from a single manufacturer.

B. Fuses shall be of the high interrupting rating, current limiting type and manufactured by the Bussman, Mersen, Cooper Edison or Littelfuse.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment in accordance to the National Electric Code.

B. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

C. Ensure that fuses are firmly and completely inserted into fuse holders and that mechanical joints are tightened.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:

1. Fusible switches.
2. Non-fusible switches.
3. Molded-case circuit breakers.
4. Enclosures.

1.3 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.

1. Shop Drawings: Diagram power, signal, and control wiring.
2. Field quality-control test reports.
3. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1. Comply with NFPA 70.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Square-D/Group Schneider
4. Cooper/Bussmann – Power Module

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Fusible Switch, 1200A and Smaller: NEMA 12, heavy duty type , with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

B. Non-fusible Switch, 600A and Smaller: NEMA-12, heavy duty type, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit (where required): Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

D. Elevator (New Installation Only)

1. Provide Elevator Control Switch in a single NEMA 12 enclosure with all necessary relay(s), control transformer and options (as listed below) and as shown within Contract Documents. The Elevator Control Switch shall be constructed, listed and certified for use with elevator control. The Elevator Control Switch shall have an ampere frame rating meeting minimum ampere requirements of selected elevator and shall include a horsepower rated fusible switch with shunt trip capabilities. The ampere rating of the switch shall be based upon elevator manufacturer requirements and utilize Class J Fuses which are provided by the Electrical Contractor. The Elevator Control Switch shall include 100 VA control power transformer with primary and secondary fuses. The primary voltage rating shall match the incoming elevator supply voltage with a 120 volt secondary. It shall also contain an isolation relay (3PDT, 10 amp, 120V). The coil of the isolation relay shall be 120v. A normally open dry contact shall be provided by the Fire Alarm Safety System to energize the isolation relay and activate the shunt trip solenoid (140 VA @ 120vAC). The switch shall include a 120 volt key to test switch and a 1-NO/1-NC mechanically interlocked auxiliary contact rated 5A, 120vAC as standard. The switch shall contain the following options:

a. “ON” Green pilot light
b. Isolated Full Capacity Neutral Lug
c. Fire Alarm Voltage Monitoring Relay (Needed to comply with NFPA 72)
d. Main Switch Auxiliary Contacts (1 NO/1 NC)

2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Molded-Case Circuit Breaker: NEMA-1, with interrupting capacity to meet available fault currents.

B. 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 250A and larger.

1. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
2. Current-Limiting Circuit Breakers: Frame sizes 400A and smaller and let-through ratings less than NEMA FU 1, RK-5.
3. GFCI Circuit Breakers: Single- and two-pole configurations with 5mA trip sensitivity.

C. Molded-Case Circuit-Breaker Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical style with lug kits suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.

4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
5. Shunt Trip: 120V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

2.4 ENCLOSURES

A. NEMA-1 minimal rating or otherwise required meeting environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 4.
2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

1. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 03.

B. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

C. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."

3.2 FIELD QUALITY CONTROL

A. Prepare for acceptance testing as follows:

1. Inspect mechanical and electrical connections.
2. Verify switch and relay type and labeling verification.
3. Verify rating of installed fuses.

B. CLEANING

1. On completion of installation, inspect interior and exterior enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 262816

SECTION 262923 - ADJUSTABLE FREQUENCY DRIVES (AFD's/VFD's)

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 23 Specification Sections, Division 26 Specifications with particular requirements to Specification 260519 "Wires and Cables" and 230513 "Common Motor Requirements for HVAC Equipment" apply to this Section.

1.2 SUMMARY

A. This Section includes solid-state, pulse-width modulated (PWM), adjustable frequency drive (AFD) for speed control of three-phase, squirrel-cage induction motors.

B. Provide adjustable frequency drive package(s) for air handling equipment, pump motors or specified motors where call for within contract documents with input power at the voltage and phase as indicated. AFD's including combination starters shall be provided by the Electrical Contractor where not provided by manufacturer/supplier. Air handling including pump drives shall be installed, programmed and commissioned by the Electric Contractor. The Electrical Contractor shall coordinate installation and particular programming requirements with Temperature Controls Contractor. The output power rating of the speed drive shall not be less than the full load rating of the motor, plus 10%.

1. Drive manufacturer and the Electrical Contractor shall supply drive, components and all necessary controls as herein specified and noted within Contract Documents.
2. Drive manufacturer shall have engaged in the production of this type for a minimum of twenty years.

1.3 SUBMITTALS

A. Product Data: For each type of AFD.

B. Shop Drawings: For each AFD.

1. Include all relevant wiring diagrams.
2. Dimensions, weight and conduit entry locations.

C. Line and load conductor(s) characteristics including control cables

D. Operation and maintenance manuals

E. Load-current and list of recommended configuration settings.

F. Provisions to ascertain compliance with IEEE Standard 519 in limiting harmonic currents.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.

B. NEMA ICS 3.1 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.

C. Drives and options shall be listed by Underwriters Laboratories, Inc. as a complete assembly.

D. Drive shall be UL listed for 65,000 amps IC without the need for input fuses.

E. Drives brand labeled by third party manufacturers are not acceptable.

F. Compliance of drive assembly via calculations showing THD less than 5% per IEEE standard 519.

G. Drive shall have a minimum MTBF rating greater than 25 years (220,000 hrs)

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions, unless otherwise indicated:

1. Ambient Temperature: 0 to 122 deg F.
2. Humidity: Less than 95 percent (non-condensing).
3. Altitude: Not exceeding 3300 feet.
4. Enclosure: Provide rated enclosure for area in which it's installed including meeting UL requirements of plenum areas. Minimum requirement: NEMA 12.

1.6 COORDINATION

A. Coordinate features of ASD's, installed units and accessory devices with pilot devices and control circuits to which they connect.

B. Coordinate features, accessories, and functions of each ASD and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load. Include final internal and external control requirements with Temperature Controls Contractor and Fire Alarm Contractor.

1.7 OPERATION AND MAINTENANCE DATA

A. Operation Data: Include instructions for starting and operating drives, and describe operating limits that may result in hazardous or unsafe conditions.

B. Maintenance Data: Include routine preventive maintenance schedule. Provide schematic diagrams for all printed circuit boards, to include part numbers of all components. Owner will sign letter of confidentiality for proprietary material. Per drive, provide three (3) copies of this information plus three (3) copies of service manual for trouble shooting the drive.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of division.

B. Accept drives on site in original packing. Inspect for damage.

C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle in accordance with manufacturer's written instruction. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure, and finish.

1.9 MAINTENANCE SERVICE

A. Furnish service and maintenance of each drive for one (1) year from date of project completion.

1.10 WARRANTY

A. Manufacturer shall provide a full three (3) year warranty on adjustable frequency drive. Warranty shall cover 100% of the cost to repair or replace any assembly part required over the first three (3) years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provided drives shall be of one manufacturer and subject to compliance with requirements. Provide products by one of the following:

1. Yaskawa, by Stoermer-Anderson
2. ABB
3. Allen Bradley

2.2 ADJUSTABLE FREQUENCY DRIVES

A. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide adjustable speed of an NEMA MG 1, Design B, 3-phase induction motor by adjusting output voltage and frequency.

1. Design and Rating: Match operation load type such as fans, blowers, pumps and type of connection used between motor and load such as direct or through a power-transmission connection.

B. Furnish and install the latest design solid state speed drives (and assembly of) to vary the speed of the indicated motors. The drive to automatically adjust (modulate) the motor speed in response to a 4 to 20mA input signal to the drive or as required by the Temperature Control Contractor, with a 6 to 90 hertz output to the motor. All components and designs to be per NEC. The drive to be fully compatible with the motor; obtain motor manufacturer’s concurrence.

C. The drive shall be suitable for motors driving fans or pumps. Refer to plans and specifications for motor and pump data and characteristics. Rectifier to be full wave type. Displacement power factor to be 0.96 minimum. Maximum total harmonic distortion (THD) to be limited to 5%.

D. Drive to be designed for stepless speed changing and continuous operation at any speed (frequency) within the specified frequency range. Drive design to be such that openings of motor leads and operation of protective features do not cause component failure. Linear speed control to be from 10 to 100% of maximum speed, unaffected by input voltage changes of plus or minus 10% rated voltage. Both the minimum and maximum speed limits; acceleration and deceleration rates; and volts-to-hertz ratio shall be adjustable. Provide current limit function to avoid excessive automatic acceleration and deceleration when an over current condition exists. Drive to provide for “soft” start, with adjustable starting frequency.

E. Output frequency to remain stable at its operating point in spite of input voltage, input frequency and temperature variations within the specified ranges.

F. The speed control output transistors are to be configured to switch frequency of up to 20 kHz to eliminate the audible noise associated with drive designs. The audible noise emitted from the motor must be within 5 db of the noise during across-the-line operations at all frequencies within the human audible spectrum (up to 10 kHz operating frequency).

G. The drive shall permit disconnection of power from the input or output line voltage with the drive running under load without damage to the drive components. The drive shall be able to

withstand an output line short (phase-to-phase or phase-to-ground) without damage to the drive components. Drive shall shutdown on short circuit and detection of any of the following conditions: current 150% above rated current; phase loss; input over voltage and under voltage; high internal temperature; ground fault and under frequency.

H. The AFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to set point without safety tripping or component damage (flying start.)

I. The AFD shall include a coordinated AC transient protection system consisting of 4-120 joule rated MOV's (phase to phase and phase to ground), a capacitor clamp, and 5% impedance reactors.

J. The drive shall have an automatic restart function to attempt restart after the unit trips off when power is lost to the unit. A time delay shall be provided between restarts. The unit shall not attempt to restart more than five (5) times in the automatic mode. In addition, the drive shall have a "power dip" ride-thru feature to prevent unnecessary trip-out due to momentary input power interruptions.

K. The drive shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, relay output and over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false under load condition.

L. The drive shall not create any feedback noise on the input line that will adversely affect electronic or microprocessor based equipment (such as computers or sensitive equipment) and the drive shall not impress voltage or current spikes on the supply system. The minimum requirements shall conform to IEEE Standard 519, Special Applications for Line Notching and Distortion. The manufacturer shall provide at no additional cost any equipment to comply with IEEE 519.

M. Communications: The drive shall have an RS-485 port as standard. The Building Automation System (BAS) protocol used shall be compatible with devices provided by the Temperature Controls Contractor such as BACnet, Lon Works, Metasys N2, Modbus/Memobus, and Apogee. Final protocol shall be verified with Controls Contractor prior to ordering AFD's and supporting hardware/software.

1. If additional hardware is required to obtain BAS protocol as required by the Temperature Controls Contractor, the drive manufacturer shall supply required interfaces. Multiple drives sharing one gateway shall not be acceptable.
2. Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process adjustable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the drive relay output status, digital input status and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus.
3. A minimum of 15 field parameters shall be capable of being monitored.
4. The AFD shall allow the DDC to control the drive's digital and analog outputs via the serial interface. This control shall be independent of any AFD function. For example, the analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive's digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition,

all of the drive's digital and analog inputs shall be capable of being monitored by the DDC system.

N. Combination Motor Circuit Protector (MCP) circuit breaker and integral disconnect switch shall be provided to disconnect from the line source prior to clearing of upstream branch circuit protection.

O. Provide controls mounted in face of the enclosure or keypad for the following functions:

1. The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable).

    a. Output Frequency
    b. Motor Speed (RPM, %, or Engineering units)
    c. Motor Current
    d. Calculated Motor Torque
    e. Calculated Motor Power (kW)
    f. DC Bus Voltage
    g. Output Voltage

P. The following indicating lights (LED type) shall be provided. A test mode or push to test feature shall be provided.

1. Power-on (Ready)
2. Run enable (safeties) open
3. Drive mode select damper opening
4. Drive running
5. Drive fault
6. Safety open
7. Damper opening
8. Damper end-switch made

Q. Protective and miscellaneous features, to include:

1. The digital inputs for the system shall accept 24V or 115VAC (selectable).
2. Customer Interlock Terminal Strip – provide a separate terminal strip for connection of freeze, fire, smoke contacts, status and external start command. Drive digital I/O points shall be prewired to interlock terminal strip and labeled accordingly.
3. Control power for field interlocks shall be provided by the drive and shall be interlocked with drive operating disconnect switch.
4. The drive shall include a "run permissive circuit" that will provide a normally open contact whenever a run command is provided. The drive shall not operate the motor until it receives a dry contact closure from a damper, valve end-switch or DDC (BAS) permissive signal. When the drive system safety interlock (fire detector, freezestat, high static pressure switch, etc) opens, the motor shall coast to a stop and the run permissive contact shall open, closing the damper or valve or other control interfaces.
5. Output current limiting, without tripping by momentary overloads.
6. Instantaneous over current tripping on phase to phase short circuits, high overloads and ground faults for both drive and connected motor.
7. Under voltage tripping on power or phase loss.
8. Over voltage tripping.
9. Over temperature tripping.
10. Visual indication of tripping causes. (Current limit, instantaneous cover current trip, under voltage, over voltage).
11. Over temperature, decelerating limit.
12. Speed indicator.

13. DC injection breaking before start.
14. A spare set of fuses of each type and ampere rating shall be provided.
15. Operating disconnect handle on front of the drive with provisions for locking in OFF position.
16. Drive output reactors to protect motors from reflected waves on long motor lead lengths.
17. Filters of radio frequency interference to attenuate possible drive generated noise shall be provided.

R. Drive enclosure with required accessories shall be mounted within enclosure rated for environment with UL certification label. Provide forced ventilation with filtration when installed in environments which negatively affect drive performance, longevity and functionality.

2.3 PROVIDED ACCESSORIES

A. Devices shall be factory installed in drive enclosure, unless otherwise indicated.

B. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

C. Latest software version and required accessories (cables) required for parameter upload/download shall be provided.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Select features of each drive to coordinate with ratings and characteristics of supply circuit and motor; required control sequence and duty cycle of motor, drive, and load.

B. Select horsepower rating of drives to suit motor being controlled.

3.2 INSTALLATION

A. Installation by Electrical Contractor. Settings and system performance coordinated with Temperature Controls Contractor.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems" or as required by drive manufacturer.

C. Drive Fuses (where provided): Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

D. Motors connected to inverter controllers shall also comply with requirements of Division 23 Specification 230513 “Common Motor Requirements for HVAC Equipment” when such equipment is included in Contract Documents. At a minimum, motors connected to inverters shall comply with the following:

1. Motors shall comply with Energy Independence and Security Act of 2007.
2. Motors shall comply with NEMA MG 1 table 12-11 and 12-12 unless noted otherwise.

3. Motors connected to inverter controllers shall be inverter rated complying with NEMA MGI parts 30 and 31. Shaft mounted grounding ring such as AEGIS bearing protection ring shall be provided.

3.3 IDENTIFICATION

A. Identify AFD's, components, and control wiring according to Division 26 Section "Electric Identification"

B. Operating Instructions: Frame printed operating instructions for drives, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of drive units.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between drives and remote devices. Bundle, train, and support wiring in enclosures. Each unit to be complete with all interconnecting wiring and connections between components within unit and to terminal board for connection to remote devices. Each wire to have an identifying number at each end.

B. Connect hand-off-automatic switch and other automatic-control devices where applicable.

1. Connect selector switches to bypass only manual and automatic-control devices that have no safety functions when switch is in hand position.
2. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

C. Terminal Board: Each unit to be provided with terminal boards completely accessible from the front by which line, load and control connections may be made and disconnected. Each terminal board to have all terminals clearly marked and all wiring between terminals to be provided, including connections to all extra and unused terminals on auxiliary contacts, relays and control devices, etc.

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each enclosed drive element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

1. Inspect drives, wiring, components, connections, and equipment installation. Program, configure and test drives, components, and equipment.
2. Assist in field testing of equipment including pretesting and adjusting of solid-state drives.
3. Report results in writing.

C. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS. 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.

3.6 TRAINING

A. Manufacturer to provide competent, well-trained supervisor to instruct the Owner's personnel in the proper maintenance and care of the equipment. Instruction period, exclusive of installation and startup time, to consist of one (1) eight (8) hour period for all equipment specified in this section of specification. Cost shall be included in Electrical Contractor's bid.

END OF SECTION 262923

SECTION 265100 INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SCOPE

A. Contractor shall furnish and install interior lighting fixtures and lamps as indicated in Fixture Schedule shown within Contract documents, and specified herein.

B. Lighting fixtures are indicated within Contract documents with an identifying letter and number. Refer to the fixture schedule which identifies the light fixtures.

1.2 SUBMITTALS

A. Product Data: For each type of lighting fixture scheduled, arranged in order of fixture designation. Include data on features, accessories, finishes and the following:

1. Physical description of fixture, including dimensions and verification of indicated parameters.
2. Fluorescent and high-intensity-discharge ballasts.

B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, method of field assembly, components, features and accessories.

C. Wiring Diagrams: Power, signal and control wiring.

D. Product Certificates: For each type of ballast for dimmer-controlled fixtures, signed by product manufacturer.

E. Source quality-control test reports.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation and maintenance manuals. In addition to items specified in Division 1 include the following:

1. Catalog data for each fixture. Include the diffuser, ballast and lamps installed in that fixture.

H. Warranties: Special warranties specified in this Section.

I. Safety chain details.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

B. Comply with NFPA 70.

C. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

D. Underwriters Laboratory

1. Fluorescent, HID, Incandescent - UL 1598
2. Track - UL 1574
3. Exit and Emergency - UL 924

1.4 COORDINATION

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

B. Electrical contractor is responsible to determined ceiling areas used as plenums. Fixtures installed in these areas shall be rated and listed for use.

1.5 WARRANTY

A. Special Warranty for Fluorescent Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.

1. Warranty period for Electronic Ballasts: Five (5) years from date of substantial completion.

PART 2 - PRODUCTS

2.1 FIXTURES AND COMPONENTS, GENERAL

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 accidently during relamping and when secured in operating positions.

E. Plastic Diffusers, Covers and Globes:

1. Acrylic Lighting Diffusers: 100% 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" minimum unless different thickness is scheduled.
   b. UV stabilized.
2. Glass: Annealed crystal glass, unless otherwise indicated.

F. Electromagnetic-Interference Filters: A component of fixture assembly. Suppress conducted electromagnetic-interference as required by MIL-STD-461D. Fabricate lighting fixtures with one filter on each ballast.

G. Air-Handling Fluorescent Fixtures: For use with plenum ceiling for air return and heat extraction.

1. Heat Removal Units. Air path leads through lamp cavity.

2. Static Fixtures: Air supply slots are blanked off, and fixture appearance matches active units.
3. Fixtures used as air handling registers shall be listed and marked for air handling use per requirements of NFPA 90A.

H. Low voltage transformer: Where provided by the Electrical Contractor or furnished by lighting manufacturer, the low voltage transformer shall be protected by fuses sized according to transformer manufacturer. Provide fuses and spares per Specification 262813 “Fuses.”

I. Solid state transformers for low voltage lighting shall not be used for dimming applications unless the assembly (transformer and dimmer) are UL listed specifically indented for such application.

2.2 LIGHTING FIXTURES

A. Fixtures type and features: See schedule for basis of design.

B. All fluorescent strip fixtures shall have tube protectors to contain broken tubes.

C. Manufacturers: Submitted manufacturer must meet minimal features, options and specifications per base of design manufacturer as scheduled or noted.

2.3 FLUORESCENT LAMP BALLASTS

A. Spare allocation: The electrical Contractor shall furnish 2% spare ballast of each type to the Owner at project completion along with an index listing fixture location where spares shall be used.

B. Description: Include the following features, unless otherwise indicated:

1. Designed for type and quantity of lamps indicated at full light output.
2. Ballast shall be individually fused externally with slow-blow type rated between 2.65 and 3.0 times the line current or as recommend by manufacturer.

C. Electronic ballasts for linear lamps shall include the following features, unless otherwise indicated and shall be provided by one manufacture:

1. Manufacturers:

a. Sylvania Quicktronic (Basis of Design)
b. Universal
c. Advance Transformer
d. GE UltraStart
e. Approved equal.

2. Ballast shall be type: Program Start (PS) – no exceptions unless otherwise indicated.
3. Ballast shall be manufactured in an ISO 9001/ISO 9002 Certified Facility.
4. Ballast shall operate local and a remote lamp from a tandem mounted fixture allowing a ballast to operate two fixtures.
5. Ballasts (1-4 lamp) shall operate as a parallel circuit, allowing remaining operation lamp(s) to maintain full light output if one or more lamps fail.
6. Ballasts shall operate from 60 Hz input source of 108 through 305 volts with sustained variations of ± 10% (Voltage & Frequency) with no damage to the ballasts.
7. Ballasts shall comply with FCC Part 18 non-consumer equipment for EMI (power line conducted) and RFI (Radiated).
8. Ballast shall have a sound rating of A.
9. Ballasts shall be Underwriters Laboratory (UL 935) listed, Class P, Type 1 Outdoor, and CSA certified where applicable.

10. Ballast shall be a high frequency electronic type and operate lamps at a frequency above 40 kHz to minimize interference with infrared control systems.
11. Total harmonic distortion rating of less than 10% according to NEMA C82.11.
12. Transient Voltage Protection; IEEE C62.41, Category A.
13. Lamp current Crest Factor: Less that 1.7.
14. Ballast shall have a power factor greater than 0.98% for primary lamp.
15. Ballast shall not contain any PCB and shall be UL listed.
16. Dimming ballast shall be compatible with control device.
17. Ballast shall tolerate sustained open circuit and short circuit output conditions without damage.
18. Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship.

D. Ballasts for compact lamps in recessed fixtures shall have the following features, unless otherwise indicated.

1. Type: Electronic.
2. Power Factor: 90%, minimum.
3. Flicker: Less than 5%.
4. Lamp Current Crest Factor: Less than 1.7.
5. Electronic Ballast Operating Frequency: 20 kHz or higher.
6. Lamp end-of-life detection and shutdown circuit.
7. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.
8. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.

E. Ballasts for compact lamps in non-recessed fixtures shall include the following features, unless otherwise indicated.

1. Power Factor: 90%, minimum.
2. Ballast Coil Temperature: 65degC, maximum.
3. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.
4. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitation on electromagnetic and radio-frequency interference for non-consumer equipment.

2.4 HIGH-INTENSIFY-DISCHARGE LAMP BALLASTS

A. General: Comply with NEMA C82.4 and UL 1029. Shall include the following features, unless otherwise indicated.

1. Type: Constant-wattage autotransformer or regulating high-power-factor type.
2. Minimum starting Temperature: -22degF for single-lamp ballasts.
3. Normal Ambient Operating Temperature: 104degF.
4. Open-circuit operation that will not reduce average life.
5. Core & Coil ballasts shall be designed to operate for 60,000 hours of continuous operation at their maximum rated temperature.
6. All capacitors shall be dry film type with no exposed live parts. Dry film capacitors shall have a 105°C maximum case temperature rating. All dry film capacitors shall be manufactured by the ballast manufacturer.
7. All capacitors will be provided with a self-contained internal bleeder resistor where required according to UL1029.
8. All ignitors will be polyester resin-filled. The ignitor shall be designed to provide six months of open lamp circuit operation without failure. Ignitors shall have a case rating temperature of 105°C. and shall be designed to withstand 10,000 hours of continuous pulsing. Ignitors shall have no exposed live parts.
9. Only accepts Type-O lamp for open fixtures. Exclusionary socket design to comply with 2005 National Electric Code.

B. Low-Noise Ballasts: Manufacturer's standard epoxy-encapsulated models designed to minimize audible fixture noise.

2.5 EXIT SIGNS

A. Type and features: See schedule for design bases.

B. General: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.

C. Manufacturers: Submitted manufacturer must meet minimal features, options and specifications per base of design manufacturer as scheduled.

D. Internally Lighted Signs:

1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum of rated lamp life.

2.6 FLUORESCENT EMERGENCY EGRESS FIXTURES

A. Emergency and Night Light Connection: Operate fluorescent lamps continuously. Connect number of lamps as indicated. Connect un-switched room circuit to emergency system and/or electrical contractor mounted battery backup module (mounted on fixture) and switched circuit to remaining fixture ballast.

1. Ballasted fluorescent egress fixtures and exit signs shall comply with NEC Articles 410.73(E)(3) and 410.73(E)(4). EC shall adjust fixture catalog number for compliance where required.

2.7 LAMPS

A. The Electrical Contractor shall provide all project required lamps at wattage, voltage and of base type as indicated or implied on contract documents or otherwise scheduled.

B. Lamps shall be low-mercury complying with Federal Toxic Characteristic Leaching Procedure (TCLP) test and yield less than 0.2 mg of mercury per liter.

C. FLUORESCENT LAMPS

1. T8 lamps shall be Octron XP XL Supersaver. Lamps shall be designed to pass Federal TCLP test in force at time of manufacture. Lamps shall have an average lamp life of (32 watt) 50,000 hours, (28watt) 80,000, 2600 initial lumens (minimum), CRI of 85 (minimum), color temperature of 4100 K, unless otherwise indicated. Basis of design Sylvania
2. T5 lamps shall be UL lamps, CRI = 85 with an efficiency of 94 lumens/watt. Lamps shall operate in a standard English system light fixture. Lamps shall have an average lamp life of 30,000 hours
3. Compact Flourescent Lamps: CRI 82 (minimum), color temperature 4100 K, average rated life of 10,000 hours at 3 hours operation per start, unless otherwise indicated.

2.8 LIGHTING CONTROLS

1. Refer to schedules or Contract documents for project lighting control devices. See specification Section 262726 "Wiring Devices" and 260923 "Lighting Control Devices".
2. All lighting controls and associated equipment shall comply with applicable State, UL and National Electrical Code requirements, and shall be installed to conform to manufacturer's and code specifications.

3. All switching devices that control fluorescent ballasts shall employ zero-crossing switching technology, or otherwise be designed to withstand high inrush current that may be caused by electronic ballasts.
4. All occupancy (motion) sensors shall be approved by the Authority having jurisdiction where applicable.
5. Specified dimming ballasts shall be electronic (solid state) and compatible with switching control.
6. Light Level Sensor:

    a. UL listed light level sensor shall be capable of detecting changes in ambient lighting levels and shall be designed for use with a dimming ballast, occupancy control system at system voltage to which they are connected. Sensor light level shall be adjustable and have a set level range from 10 to 100 footcandles (100 to 1000 lux), minimum. Sensor shall have a bypass function to electrically override sensor control where made available.
    b. Photocells which control lighting equipment shall be compatible with the ballasts they control, and shall be installed as directed by the photocell and ballast manufacturers. Photocells shall comply with applicable State requirements.
    c. Photocell and other sensors used for lighting control shall be installed with five feet of slack wire (nearest junction box) to permit subsequent relocation without the need for rewiring.
    d. Photocell(s) where used for exterior lighting time clock control or building automation system shall be compatible with said system and comply in function with IECC-2003 Section 805.2.3.

7. Control systems that include both occupancy sensors and photocells shall be installed as indicated by the control manufacturer to assure compatibility.
8. Before calibrating a dimming control system, all lamps shall be operated at full output for at least 100 hours to assure stable dimming operation.
9. Passive infrared occupancy sensors or ultrasonic type shall be "masked" as required to prevent sensors from detecting motion outside the area they are controlling. The masking material shall be provided by the occupancy sensor manufacturer expressly for this purpose.

2.9 FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Supporting Devices" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2" steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2" steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641, Class 3, soft temper, zinc-coated, 12 gage.

E. Wires for Humid Spaces: ASTM A 580, Composition 302 or 304, annealed stainless steel, 12 gage.

F. Rod Hangers: 3/16" minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord and locking-type plug.

H. Aircraft Cable Support: Use cable, anchorages and intermediate supports recommended by fixture manufacture.

2.10 FINISHES

A. Fixtures: Manufacturer's standard, unless otherwise indicated.

1. Paint Finish: Applied over corrosion-resistant treatment or primer free of defects.
2. Metallic Finish: Corrosion resistant.

2.11 SOURCE QUALITY CONTROL

A. Factory test fixtures with ballasts and lamps; certify results for electrical ratings and photometric data.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixtures: Set level, plumb and square with ceilings and walls. Install lamps in each fixture.

B. Support for fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.

1. Support Clips: Electrical Contractor shall secure fixtures to ceiling grid members at or near each fixture corner with manufacture clips which are UL listed for the application or by securely fasten to ceiling members via bolts, screws or rivets. Where fixtures weighing 56 pounds or more shall be connected via four wires, one at each corner terminating to above structure.
2. 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 (2) 3/4" metal channels spanning and secured to ceiling tees.
3. Recessed incandescent or compact fluorescent downlight fixtures in suspended ceilings weight 20 pounds or more shall be supported by connecting at least one fixture support wire to the fixture housing terminating to above structure.
4. Wire hangers may be wrapped cable or closed link chain. In all cases, the hanger shall be of sufficient strength to support the weight of the unit with a factor of safety of four (4). Where "S" hooks are used and allowed per manufacture installation guidelines, both ends shall be completely closed after installation.

C. Suspended Fixture Support: As follows:

1. Pendants and Rods: Where longer than 48", 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.
4. Continuous Rows: Suspend from cable.
5. As recommended by fixture manufacturer.

D. Adjust fixtures to provide required light intensities.

3.2 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.

3.3 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. A few of the first recessed fixtures shall be checked as soon as they are suspended, to determine if any sagging or twisting of the ceiling system exists and if fixtures are firm and hang straight.

C. Finally, after fixtures and lamps have been installed, the ceiling shall be rechecked for sagging, and any corrections shall be the responsibility of the Electrical contractor.

D. Verify normal operation of each fixture after installation.

E. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify normal transfer to battery power source and retransfer to normal.

F. Prepare a written report of test, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standard.

G. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.

END OF SECTION 265100

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SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 BIDDING INFORMATION

A. In order to save time, the Owner has received proposals for various light fixtures as scheduled on the drawings. The Owner is evaluating proposals and will issue a purchase order to the successful bidder for the light fixtures.

B. Subsequently, the Owner will award contract to an Electric Contractor for installation of the light fixtures and other associated electric work. The Electric Contractor will receive, will handle, will install and will assume the same responsibilities as though the contractor had initially invited proposals and made award on these light fixtures.

C. The light fixtures shall be complete in all details, shall be factory assembled and tested and delivered F.O.B. Cincinnati, Ohio to a location specified by the Electric Contractor at a later date. The light fixture supplier shall include all freight charges in his bid. The successful Electric Contractor will accept light fixtures in Cincinnati, will deliver light fixtures to the building, will include in his bid all local freight, hauling and rigging, will furnish all necessary labor and supervision to install the light fixtures and place into operation.

D. The start-up of the light fixtures shall be performed by the contractor and the cost of same shall be included in his proposal. All details of construction and installation shall meet the approval of the Engineer. Supplier shall provide, in addition, the operating instructions and the equipment operation and performance information as hereinafter specified.

E. The entire installation shall comply with all local laws, laws of the State of Ohio, and the National Electrical Code.

1.2 SCOPE

A. Contractor shall install all emergency and exit lighting fixtures as indicated in Fixture Schedule shown within Contract documents, and specified herein.

B. All emergency and exit lighting fixtures are indicated within Contract documents with an identifying letter and number. Refer to the fixture schedule which identifies the light fixtures. On the light fixture schedule, note which fixtures are being pre-purchased by the owner and which fixtures shall be supplied by the contractor.

1.3 RELATED DOCUMENTS

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

1.4 SUMMARY

A. Section Includes:
   1. Interior solid-state luminaires that use LED technology.

1.5 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Photometric data and adjustment factors based on laboratory tests.

B. Shop Drawings
1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. Use same designations indicated herein.

D. Samples for Verification: For each type of luminaire.
1. Include Samples of luminaires and accessories to verify finish selection.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.

1.9 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.11 WARRANTY

A. Warranty: Supplier shall agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five years parts and labor with no proration from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Recessed Fixtures: Comply with NEMA LE 4.

C. CRI of minimum 82. CCT of 3500 K.

D. Rated lamp life of 50,000 hours based upon a minimum of compliance with IES TM.21 (LM-79/80/90).

E. Lamps dimmable from 100 percent to 10 percent of maximum light output.

F. Internal driver.

G. Nominal Operating Voltage: 120V or 277V (Universal).

K. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

L. Housings:
1. Extruded-aluminum housing and heat sink.

H. Fixtures must be DLC rated.

2.2 RECESSED LINEAR

A. Minimum lumens and minimum allowable efficacy per schedule.

B. Integral junction box with conduit fittings.

2.3 MATERIALS

A. Metal Parts:
1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers:
1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Housings:
1. Extruded-aluminum housing and heat sink.

E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp characteristics:
a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI for all luminaires.

2.4 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Coordinate the following examination procedures with the successful electrical contractors.

B. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

C. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation.

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

3.2 INSTALLATION

A. Coordinate the following installation procedures with the successful electrical contractors.

B. Comply with NECA 1.

C. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

D. Supports:
1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Ceiling-Grid-Mounted Luminaires:
1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.3 FIELD QUALITY CONTROL

A. Coordinate the following Field Quality Control procedures with the successful contractors.

B. Perform the following tests and inspections:
1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

C. Luminaire will be considered defective if it does not pass operation tests and inspections.

D. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Provide factory trained technician to attend lighting demonstration.

3.5 ADJUSTING

A. Coordinate the following adjusting of light fixtures with the successful contractors.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two

visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Engineer.

END OF SECTION 265119

SECTION 265219 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 BIDDING INFORMATION

A. In order to save time, the Owner has received proposals for various light fixtures as scheduled on the drawings. The Owner is evaluating proposals and will issue a purchase order to the successful bidder for the light fixtures.

B. Subsequently, the Owner will award contract to an Electric Contractor for installation of the light fixtures and other associated electric work. The Electric Contractor will receive, will handle, will install and will assume the same responsibilities as though the contractor had initially invited proposals and made award on these light fixtures.

C. The light fixtures shall be complete in all details, shall be factory assembled and tested and delivered F.O.B. Cincinnati, Ohio to a location specified by the Electric Contractor at a later date. The light fixture supplier shall include all freight charges in his bid. The successful Electric Contractor will accept light fixtures in Cincinnati, will deliver light fixtures to the building, will include in his bid all local freight, hauling and rigging, will furnish all necessary labor and supervision to install the light fixtures and place into operation.

D. The start-up of the light fixtures shall be performed by the contractor and the cost of same shall be included in his proposal. All details of construction and installation shall meet the approval of the Engineer. Supplier shall provide, in addition, the operating instructions and the equipment operation and performance information as hereinafter specified.

E. The entire installation shall comply with all local laws, laws of the State of Ohio, and the National Electrical Code.

1.2 SCOPE

A. Contractor shall install all emergency and exit lighting fixtures as indicated in Fixture Schedule shown within Contract documents, and specified herein.

B. All emergency and exit lighting fixtures are indicated within Contract documents with an identifying letter and number. Refer to the fixture schedule which identifies the light fixtures. On the light fixture schedule, note which fixtures are being pre-purchased by the owner and which fixtures shall be supplied by the contractor.

1.3 RELATED DOCUMENTS

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

1.4 SUMMARY

A. Section Includes:
   1. Emergency lighting units.
   2. Exit signs.

1.5 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.

D. Fixture: See "Luminaire" Paragraph.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.
1. Include data on features, accessories, and finishes.
2. Include physical description of the unit and dimensions.
3. Battery and charger for light units.
4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.

B. Shop Drawings:
1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Samples for Verification: For each type of luminaire.
1. Include Samples of luminaires and accessories to verify finish selection.

D. Product Schedule:
1. For emergency lighting units.
2. For exit signs.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.
1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
2. Luminaire-mounted, emergency battery pack: One for every 50 emergency lighting units. Furnish at least one of each type.
3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.

1.9 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.11 WARRANTY

A. Warranty: Supplier shall agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five year(s) from date of Substantial Completion.

B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Emergency Power Unit Batteries: 5 years from date of Substantial Completion. Full warranty shall apply for the entire warranty period.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

D. Comply with NEMA LE 4 for recessed luminaires.

E. Comply with UL 1598 for fluorescent luminaires.

F. Lamp Base: Comply with ANSI C81.61.

G. Bulb Shape: Complying with ANSI C79.1.

H. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.
   1. Emergency Connection: Operate two lamps continuously at an output of 1100 lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
   2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
   3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
      a. Ambient Temperature: Less than 0 deg F or exceeding 104 deg F, with an average value exceeding 95 deg F over a 24-hour period.
      b. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.
      c. Humidity: More than 95 percent (condensing).
   4. Nightlight Connection: Operate lamp continuously at 40 percent of rated light output.
   5. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
      a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
      b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
   6. Battery: Sealed, maintenance-free, nickel-cadmium type.
   7. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
   8. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
   9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.2 EMERGENCY LIGHTING

A. General Requirements for Emergency Lighting Units: Self-contained units.

B. Emergency Luminaires:
   1. Emergency Luminaires: As indicated on Lighting Fixture Schedule and described herein with the following additional features:
      a. Operating at nominal voltage of 120 V ac or 277 V ac (universal).
      b. Internal emergency power unit.
      c. Rated for installation in damp locations, and for sealed and gasketed luminaires in wet locations.
      d. UL 94 flame rating.

C. Emergency Lighting Unit:
   1. Emergency Lighting Unit: As indicated on Lighting Fixture Schedule.
   2. Operating at nominal voltage of 120 V ac or 277 V ac (universal).
   3. Wall or ceiling with universal junction box adaptor.
   4. UV stable thermoplastic housing.
   5. Two Halogen lamp heads.
   6. Internal emergency power unit.

2.3 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
   1. Operating at nominal voltage of 120 v AC or 277 v AC (universal).
   2. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
   3. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

2.4 MATERIALS

A. Metal Parts:
   1. Free of burrs and sharp corners and edges.
   2. Sheet metal components shall be steel unless otherwise indicated.
   3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:
   1. Smooth operating, free of light leakage under operating conditions.
   2. Designed to permit relamping without use of tools.
   3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers:
   1. Acrylic: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   2. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Housings:
   1. Poly-carbonite housing and aluminum heat sink.

2.5 METAL FINISHES

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Coordinate the following examination procedures with the successful electrical contractors.

B. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.

C. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

D. Examine walls and ceilings for suitable conditions where emergency lighting luminaires will be installed.

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

3.2 INSTALLATION

A. Coordinate the following installation procedures with the successful electrical contractors.

B. Comply with NECA 1.

C. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

D. Install lamps in each luminaire.

E. Supports:
1. Sized and rated for luminaire and emergency power unit weight.
2. Able to maintain luminaire position when testing emergency power unit.
3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.

F. Wall-Mounted Luminaire Support:
1. Attached to structural members in walls or attached to a minimum 20-gage backing plate attached to wall structural members or attached using through bolts and backing plates on either side of wall.
2. Do not attach luminaires directly to gypsum board.

G. Ceiling Grid Mounted Luminaires:
1. Secure to any required outlet box.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.3 FIELD QUALITY CONTROL

A. Coordinate the following Field Quality Control procedures with the successful contractors.

B. Perform the following tests and inspections:
1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

C. Luminaire will be considered defective if it does not pass operation tests and inspections.

D. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Provide factory trained technician to attend lighting demonstration.

3.5 ADJUSTING

A. Coordinate the following adjusting of light fixtures with the successful contractors.

B. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:
1. Inspect all luminaires. Replace lamps, emergency power units, batteries, signs**,** or luminaires that are defective.
a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
2. Conduct short-duration tests on all emergency lighting.

END OF SECTION 265219

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SECTION 26 56 00 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SCOPE

A. Contractor shall furnish and install exterior lighting fixtures with lamps as indicated in Fixture Schedule shown within Contract documents and specified herein.

B. Lighting fixtures are indicated on the contract documents with an identifying letter and number. Refer to the fixture schedule on contract documents which identifies the light fixture.

1.2 SUBMITTALS

A. Product Data: For each luminaire, arranged in the order of lighting unit designation. Include data on features, accessories, finishes and on the following:

1. Physical description of fixture, including dimensions and verification of indicated parameters.
2. Luminaire dimensions, effective projected area, details of attaching luminaires, accessories and installation and construction details.
3. Luminaire materials.
4. Photoelectric relays.
5. High-intensity-discharge ballasts.
6. High-intensity-discharge lamps.
7. Electrical and energy-efficiency data for ballasts.

B. Shop Drawings: Anchor-bolt templates keyed to specific poles and certified by manufacturer.

C. Wiring Diagrams: Power and control wiring.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For luminaires to include in maintenance manuals.

G. Warranties: Special warranties specified in this section.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

B. Comply with IEEE C2, "National Electrical Safety Code".

C. Comply with NFPA 70.

D. Comply with IECC 2003.

1.4 WARRANTY

A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace luminaires or components of luminaires and lamps that fail in materials or workmanship; corrode; or fade, stain or chalk due to effects of weather or solar radiation within specified

warranty period. Manufacturer may exclude lightning damage, hail damage vandalism, abuse or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Three (3) years from date of Substantial Completion.
    a. Warranty Period for Metal Corrosion: Three (3) years from date of Substantial Completion.
    b. Warranty Period for Color Retention: Three (3) years from date of Substantial Completion.
2. Warranty Period for Lamps: Replace lamps and fuses that fail with 12 months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 12 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRES, GENERAL

A. Fixtures type and features: See schedule on Contract Documents for design Basis.
    1. Manufacturers: Submitted manufacturer must meet minimal features, options and specifications per base of design manufacturer as scheduled or noted within Contract documents.
    2. Complying with UL 1598 and listed for installation in wet locations.
        a. CERTIFICATION: UL listed to safety standards for wet locations. Fixture manufacturer shall employ a quality program that is audited to ISO9001 standards.

B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag or deform in use. Provide filter/breather for enclosed luminaires.

F. 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. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

2.2 CONCRETE FOUNDATIONS

A. Construct concrete foundations conforming to Section 03300, "Cast-In-Place Concrete." Comply with details shown within Contract documents and manufacturer's recommendations for reinforcing, anchor bolts, nuts, and washers.

B. Include concrete foundations for the following fixtures unless otherwise scheduled or indicated within contract documents:

1. Parking pole lights

2.3 HIGH-INTENSITY-DISCHARGE LAMP BALLASTS

A. General: Comply with NEMA C82.4 and UL 1029. Shall include the following features, unless otherwise indicated:

1. Type: Regulating high-power-factor type.
2. Minimum Starting Temperature: -20degF for H.I.D. and 0degF for fluorescent.
3. Normal Ambient Operating Temperature: 104degF.
4. Open-circuit operation will not reduce average life.
5. Ballast Fuses: One (1) in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer. Spare fuse allocation as noted in specification 262813 “Fuses”.

2.4 FLUORESCENT BALLASTS

A. General:

1. Ballasts shall be voltage rated for 60-hertz at voltages listed on lighting distribution system.
2. Ballast factor shall be no less than 0.85 when tested with a compatible lamp.
3. Ballasts and related hardware for indoor use shall start lamps at a starting temperature of 50degF. Exterior applications or where ambient temperatures may fall below 50degF, manufacturer's minimum starting temperatures for ballasts and related hardware shall be 0degF. Outdoor applications shall use Type I outdoor rated ballasts. Ballasts shall be designed for a maximum ambient temperature of 105degF.

2.5 LAMPS

A. Lamps shall comply with Federal Toxic Characteristic Leaching Procedure (TCLP).

B. Metal-Halide Lamps: ANSI C78.1372, wattage and burning position as scheduled, CRI 70 (minimum), and color temperature 4000degK.

C. Fluorescent: ANSI C78.901 - 2001, IEC 60901- 0526, CRI 82, color temperature 4100degK, 2-pin double biax or as specified via fixture manufacturer. Lamp shall be specifically designed for cold temperature applications: minimum 16degF starting temperature.

2.6 SOURCE QUALITY CONTROL

A. Factory test fixtures with ballasts and lamps; certify results for ISO foot candle curves, zonal lumen, average and minimum ratios, and electrical and energy-efficiency data for ballasts.

2.7 FIELD WIRING

A. Install a listed in-line fuseholder and fuse in each light base for all ungrounded conductors using an insulating/waterproofing boot for each fuseholder per manufacturer's instructions. A type CC non-time-delay, rejection type fuse shall be installed in each fuseholder. Size fuses in accordance to ballast or fixture manufacturer requirements. Provide adequate load and line side

conductor slack in the form of U-bends at each in-line fuseholder. Fuseholders and fuse shall be of same manufacturer per Specification 262813 “Fuses”. Fuseholder by Littelfuse, type LEC or LEY per specification.

2.8 GROUNDING

A. Ground fixtures and metal poles according to the NEC and per details shown on contract documents. Unless otherwise noted within Contract documents, install 3/4 inch by 10 foot copperclad ground rod at each pole and connect to pole ground lug using #6 bare stranded copper conductor.

2.9 PARKING LOT POLE MOUNTED LIGHT FIXTURES

A. DESIGN: All parking lot pole mounted fixtures are based on Kim Lighting.

B. All other manufactures must submit a site layout of all fixtures in AutoCAD 2008 format with point by point footcandle levels for a 20' x 20' grid, using the following parameters:

1. 100 watt metal halide at 8500 lumens
2. 175 watt metal halide at 13,500 lumens
3. 400 watt metal halide at 40,000 lumens
4. Luminaire Dirt Depreciation = 0.97
5. Lamp Lumen Depreciation = 0.80

C. LIGHT FIXTURE

1. HOUSING: One piece die-cast aluminum with integral cooling fins on the top surfaces above the optical chamber and electrical compartment. A solid barrier wall separates the optical and electrical compartments, with gasketed wire penetrations. A double-thick wall with gussets is provided on the support arm mounting end. Inset sections on each end provide for attachment of entablatures, and cradle the mounting arm. All hardware is stainless steel or electro-zinc plated steel. Entablature color to be special color as selected by the Architect. Entablature style to be selected by Architect.
2. LENS FRAME: One (1) piece die-cast aluminum with a 1" minimum thickness around the gasket flange for rigidity. Integral hinges with stainless steel pins provide no-tool mounting and removal from the housing. Two stainless steel thumb-latches are recessed into the front corners, concealed from normal view. Lens frame seals against the housing by a one piece extruded silicone gasket with vulcanized end closure. Clear 3/16" thick tempered flat glass lens is retained in the frame by eight clips with full silicone gasketing around the perimeter.
3. REFLECTOR MODULE: Specular Alzak® optical segments are rigidly mounted in an aluminum frame which attaches to the housing as a one piece module. Reflector module is field-rotatable in 90o metal halide increments. Metal halide sockets are pin-oriented mogul base or medium base with a molded silicone lamp stabilizer. All sockets are factory prewired with a quick-disconnect plug for the ballast module, with wires passing through a silicone gasket in the housing barrier wall.
4. ELECTRICAL MODULE: All electrical components are UL recognized, mounted on a single plate and factory prewired with quick-disconnect plugs. Electrical module attached to housing with no-tool hinges and latches, accessible by opening the lens frame. All ballasts are high power factor with starting temperatures of -20oF for metal halide lamps. Ballasts shall be Type CWA. Fixtures must be grounded in accordance with local codes or the National Electrical Code. Fixture voltage based on contract schedules. Ballasts to be guaranteed for two (2) years labor and materials.
5. SUPPORT ARM: One piece extruded aluminum with internal bolt guides and a recessed step to match the housing. Luminaire-to-pole attachment is by internal draw bolts, and includes a pole reinforcing plate with wire strain relief.

6. FINISH: Super TGIC thermoset polyester powder coat paint, 2.5 mil nominal thickness, applied over a chromate conversion coating; 2500 hour salt spray test endurance rating. Finish shall be Black. Finish to be guaranteed for three (3) years labor and materials.

D. LIGHT FIXTURE POLE

1. POLE CONSTRUCTION: Seamless square extruded aluminum tube of alloy 6063-T6, 0.188" wall thickness, welded to top and bottom of aluminum base casting of alloy 356. Minimum yield strength of pole: 25,000 p.s.i. Minimum yield strength of welded base plate: 30,000 p.s.i.
2. BASE COVER: Base has a two (2) piece cast aluminum full cover of 319 alloy, secured by stainless steel screws.
3. POLE CAP: Flush-sided cast aluminum pole cap.
4. HANDHOLE: 18" up from base, with a gasketed cover and ground lug.
5. ANCHOR BOLTS: Four (4) galvanized anchor bolts provided, complete with eight (8) nuts, eight (8) flat washers and template. Anchor bolts to be set in base as detailed on manufacturer drawings. Concrete base to be provided by this contractor.
6. REINFORCING SLEEVE: All poles 25' and above include an internal aluminum reinforcing sleeve, welded at the base.
7. STRENGTH: Poles will withstand sustained wind loads of 90 mph per AASHTO or NEMA standards which ever is more stringent.
8. Conduit Openings shall be 3" diameter
9. FINISH: Polyester powder coat paint, 2.5 mil nominal thickness applied over a chromate conversion coating, 2500 hour salt spray test endurance rating. Finish shall be Black. Finish to be guaranteed for three (3) years labor and materials
10. This contractor shall provide bonding/grounding for each pole base per NFPA 70.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lamps in each fixture compatible with and of wattage as scheduled.

B. Luminaire Attachment: Fasten to indicated structure supports.

C. Adjust luminaires that require field adjustment or aiming.

D. Provide shields or distribution barriers per schedule, drawings plans or as required by AHJ.

3.2 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.

3.3 CONTROL

A. Provide lighting controls, systems, components of, raceway, wiring, terminations and programming as noted on contract documents for code compliance and desired function.

B. Photocell(s) where used for exterior lighting time clock control or building automation system shall be compatible with said system and comply in function with IECC-2003 Section 805.2.3.

3.4 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Tests and Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source. Measure light intensities at night. Use photometers with calibration referenced to NIST standards.

C. 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 265600

SECTION 265619 - LED EXTERIOR LIGHTING

TIPS:

To view non-printing **Editor's Notes** that provide guidance for editing, click on Masterworks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on Masterworks/Supporting Information.

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.
3. Luminaire-mounted photoelectric relays.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 260926 "Lighting Control Panelboards" for panelboard-based lighting control.
3. Section 260943.16 "Addressable-Fixture Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.
4. Section 265613 "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. LEED Submittals:

1. Product Data for Credit EA 5: For specified metering equipment.
2. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

D. Delegated-Design Submittal: For luminaire supports.

1. Include design calculations for luminaire supports[**and seismic restraints**].

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale and coordinated.

B. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.

C. Product Certificates: For each type of the following:

1. Luminaire.
2. Photoelectric relay.

D. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.6 FIELD CONDITIONS

A. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.7 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 5 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to **ASCE/SEI 7**.

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified.

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. UL Compliance: Comply with UL 1598 **and listed for wet location**.

E. Lamp base complying with **ANSI C81.61**.

F. CRI of [**minimum**] [**65**] [**70**] [**80**] <**Insert number**>. CCT of [**2700 K**] [**3000 K**] [**4100 K**] <**Insert value**>.

G. L70 lamp life of [**35,000**] [**50,000**] <**Insert number**> hours.

H. Lamps dimmable from 100 percent to 0 percent of maximum light output.

I. Nominal Operating Voltage: [**120 V ac**] [**240 V ac**] [**277 V ac**] [**12 V dc**] [**24 V dc**].

J. In-line Fusing: [**On the primary for each luminaire**] [**Separate in-line fuse for each luminaire**].

K. Lamp Rating: Lamp marked for [**outdoor use**] [**and**] [**in enclosed locations**].

L. Source Limitations: Obtain luminaires from single source from a single manufacturer.

M. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 LUMINAIRE TYPES

A. Area and Site:

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Luminaire Shape: [**Round**] [**Square**] [**Hexagonal**] <**Insert shape or feature**>.
3. Mounting: [**Pole**] [**Building**] <**Insert mounting type**> with [**extruded-aluminum**] [**stainless-steel**] <**Insert material**> [**rectangular**] [**round**] arm, [**11 inches (280 mm)**][**13 inches (330 mm)**]in length.
4. Luminaire-Mounting Height: <**Insert height of luminaire from finished grade**>.
5. Distribution: [**Type I**] [**Type II**] [**Type III**] [**Type IV**] [**Type V**].

B. Canopy:

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Shape: [**Round**] [**Square**] <**Insert shape**>.
3. Dimensions: [**12 inches (300 mm)**] [**square**] [**in diameter**].

C. Decorative Post Top:

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Luminaire-Mounting Height: <**Insert height of luminaire from finished grade**>.
3. Mounting Type: [**Arm**] [**Tenon**] [**Ring**].
4. Distribution: [**Type I**] [**Type II**] [**Type III**] [**Type IV**] [**Type V**].

2.4 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: [**Corrosion-resistant aluminum**] [**Stainless steel**] [**Epoxy-coated steel**] <**Insert material**>. Form and support to prevent warping and sagging.

C. 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. Doors shall be removable for cleaning or replacing lenses.

D. Diffusers and Globes:

1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch ((3.175 mm)) minimum unless otherwise indicated.

E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

F. 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.

G. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

2.5 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

    a. Color: [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] <**Insert color**>.

D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

    a. Color: As selected from manufacturer's standard catalog of colors.
    b. Color: Match Architect's sample of [**manufacturer's standard**] [**custom**] color.

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

2.6 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Install lamps in each luminaire.

D. Fasten luminaire to structural support.

E. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

F. Wall-Mounted Luminaire Support:

1. [**Attached to structural members in walls**] [**Attached to a minimum 1/8 inch (3 mm) backing plate attached to wall structural members**] [**Attached using through bolts and backing plates on either side of wall**] <**Insert means of attachment**>.

G. Wiring Method: Install cables in raceways. Conceal raceways and cables.

H. [**Install luminaires level, plumb, and square with finished grade unless otherwise indicated.**] [**Install luminaires at height and aiming angle as indicated on Drawings.**]

I. Coordinate layout and installation of luminaires with other construction.

J. Adjust luminaires that require field adjustment or aiming. [**Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.**]

K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.2 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

A. Aim as indicated on Drawings.

B. Install on concrete base with top [**4 inches (100 mm)**] <**Insert dimension**> above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.3 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections[**with the assistance of a factory-authorized service representative**]:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Verify operation of photoelectric controls.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):

    a. IES LM-5.
    b. IES LM-50.
    c. IES LM-52.
    d. IES LM-64.
    e. IES LM-72.

2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. 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.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires[**and photocell relays**].

END OF SECTION 265619

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Protecting existing trees, shrubs, groundcovers, plants, and grass, to remain.
2. Removing existing trees, shrubs, groundcovers, plants, and grass as indicated on drawings.
3. Clearing and grubbing.
4. Removing above- and below-grade site improvements.
5. Disconnecting, capping or sealing, and removing site utilities.
6. Temporary erosion and sedimentation control measures.

B. Related Sections include the following:
1. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.

1.3 DEFINITIONS

A. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section "Earth Moving."

1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction and in accordance with sediment and erosion control Drawings.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

1. Arrange with utility companies to shut off indicated utilities.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Construction Manager not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Construction Manager's written permission.

C. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
4. Use only hand methods for grubbing within tree protection zone.
5. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.5 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.6 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns and grasses, and exterior plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for slabs-on-grade.
4. Subbase course for concrete walks and pavements.

B. Related Sections include the following:

1. Division 31 Section "Site Clearing" for temporary erosion and sedimentation control measures, site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
2. Division 32 Section "Turf and Grasses" for finish grading, including preparing and placing topsoil and planting soil for lawns.
3. Division 32 Section "Plants" for planting bed establishment and tree and shrub pit excavation and planting.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Course placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

A. Product Data: For the following:
1. Geotextile.
2. Controlled low-strength material, including design mixture.

1.5 QUALITY ASSURANCE

A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.

B. Geotechnical Testing Agency Qualifications: Owner will employ and pay a qualified, independent geotechnical testing laboratory to perform soil testing and inspection services during earthwork operations. Contractor shall be responsible for scheduling and coordination of these services.

C. Preexcavation Conference: Before commencing earthwork, meet with representatives of governing authorities, Owner, Architect, Structural Engineer, consultants, Geotechnical Testing Agency and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least three working days prior to convening conference. Record discussions and agreements and furnish a copy to each attendee.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner and then only after arranging to provide temporary utility services according to requirements indicated.

1. Notify Owner not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner’s written permission.
3. Contact utility-locator service for area where Project is located before excavating.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide off-site borrow soil materials when sufficient satisfactory soil materials are not available from on-site excavations.

B. Satisfactory Soils: On site soils satisfactory to testing agency, containing less than 25% pulverized shale fragments, free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, organics, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Silt, highly organic soils, wood, roots, trash, debris, and other soils and materials not acceptable to the testing agency.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

H. Drainage Course: Narrowly graded mixture of washed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.

J. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; as noted on drawings.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; as noted on the drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect and maintain erosion and sedimentation controls during earthwork operations.

C. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated utility trenches as temporary drainage ditches.
2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. For sanitary sewer, storm sewer, and water lines, please see the corresponding spec sections. For other site utilities follow below.

B. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

C. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit.

D. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.7 SUBGRADE INSPECTION

A. Notify testing agency when excavations have reached required subgrade.

B. If testing agency determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect/Engineer, without additional compensation.

3.8 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by Geotechnical Engineer.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect/Engineer.

3.9 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.11 UTILITY TRENCH BACKFILL

A. For sanitary sewer, storm sewer, and water lines, please see the corresponding spec sections. For other site utility backfill, follow below.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

C. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

D. Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings.

E. Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.

F. Place and compact initial backfill material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit in non-paved areas.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

G. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the utility pipe or conduit in paved areas.

H. Backfill voids with satisfactory soil while installing and removing shoring and bracing.

I. Place and compact final backfill of satisfactory soil to final subgrade elevation in non-paved areas.

J. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation in paved areas.

3.12 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations in accordance with sections 3.13 and 3.14 and as follows:

1. Under grass and planted areas, use satisfactory soil material or engineered fill.
2. Under walks and pavements, use satisfactory soil material (excluding topsoil) or engineered fill.
3. Under steps and ramps, use satisfactory soil material (excluding topsoil) or engineered fill.
4. Under building slabs, use satisfactory soil material (excluding topsoil) or engineered fill.
5. Under footings and foundations, use satisfactory (excluding topsoil) soil material or engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.13 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under structures, building slabs, steps, and pavements, including 10 feet beyond all such areas, compact each layer of backfill or fill soil material at 100 percent maximum dry density.

2. Under walkways, compact each layer of backfill or fill soil material at 100 percent maximum dry density.
3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent maximum dry density.
4. For utility trenches, compact each layer of initial and final backfill soil material at 100 percent maximum dry density.

3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.16 SUBSURFACE DRAINAGE

A. Subdrainage Pipe: Specified in Division 33 Section "Subdrainage."

B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698.

C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with 1 layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698.

3.17 SUBBASE AND BASE COURSES

A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase and base course under pavements and walks as follows:

1. Where specified install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Shape subbase and base course to required crown elevations and cross-slope grades.
3. Place subbase and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
4. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry density.

C. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 100 percent of maximum dry density.

3.18 DRAINAGE COURSE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place drainage course 6 inches or less in compacted thickness in a single layer.
3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 98 percent of maximum dry unit weight according to ASTM D 698.

3.19 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.20 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect/Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Transport surplus soil material offsite to a legal disposal site off Owner’s property.

1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

B. Excavated pavements shall be considered waste material and shall not be incorporated into fills.

END OF SECTION 312000

SECTION 31 63 29 - DRILLED CONCRETE PIERS AND SHAFTS

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. Dry-installed drilled piers.

1.3 UNIT PRICES

A. Drilled Piers: Actual net volume of drilled piers in place and approved. Actual length and shaft diameter, may vary, to coincide with elevations where satisfactory bearing strata are encountered. These dimensions may also vary with actual bearing value of bearing strata determined by an independent testing and inspecting agency. Adjustments are made on net variation of total quantities, based on design dimensions for shafts.

1. Base bids on indicated number of drilled piers and, for each pier, the design length from top elevation to bottom of shaft and the diameter of shaft.
2. Unit prices include labor, materials, tools, equipment, and incidentals required for excavation, trimming, shoring, casings, dewatering, reinforcement, concrete fill, testing and inspecting, and other items for complete drilled-pier installation.

B. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed outside dimensions of drilled piers cast against rock. Unit prices for rock excavation include replacement with approved materials.

C. Trial Drilled Pier: Same unit price as indicated for drilled pier, including backfilling.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to drilled piers including, but not limited to, the following:

a. Review geotechnical report.
b. Discuss existing utilities and subsurface conditions.
c. Review coordination with temporary controls and protections.
d. Review measurement and payment of unit prices.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture. Submit alternative design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Shop Drawings: For concrete reinforcement, detailing fabricating, bending, supporting, and placing.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Welding certificates.

C. Material Certificates: From manufacturer, for the following:

1. Cementitious materials.
2. Admixtures.
3. Steel reinforcement and accessories.

D. Material Test Reports: For each material below, by a qualified testing agency:

1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Record drawings.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer that has specialized in drilled-pier work.

B. Testing Agency Qualifications: Qualified according to ASTM C 1077, ASTM D 3740, and ASTM E 329 for testing indicated.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

1.9 TRIAL DRILLED PIER

A. Trial Drilled Pier: Construct trial drilled pier of diameter and depth and at location indicated or, if not indicated, of same diameter and depth as largest drilled piers, located at least three diameters clear of permanent drilled piers, to demonstrate Installer's construction methods, equipment, standards of workmanship, and tolerances.

1. Install reinforcement, fill with concrete, remove temporary casings, and terminate trial drilled pier 24 inches below subgrade and leave in place.
2. Install permanent casings and excavate rock socket as required for permanent drilled piers.
3. If Architect determines that trial drilled pier does not comply with requirements, excavate for and cast another until it is accepted.

1.10 FIELD CONDITIONS

A. Existing Utilities: Locate existing underground utilities before excavating drilled piers. If utilities are to remain in place, provide protection from damage during drilled-pier operations.

1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure if necessary to prevent damage to utilities. Cooperate with Owner and utility companies in keeping services and facilities in operation without interruption. Repair damaged utilities to satisfaction of utility owner.

B. Interruption of Existing Utilities: Do not interrupt any utility to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Owner's written permission.

C. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from this data.

1. Make additional test borings and conduct other exploratory operations necessary for drilled piers.
2. The geotechnical report is referenced elsewhere in the Project Manual.

D. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for drilled piers. Before excavating, lay out each drilled pier to lines and levels required. Record actual measurements of each drilled pier's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.

1. Record and maintain information pertinent to each drilled pier and indicate on record Drawings. Cooperate with Owner's testing and inspecting agency to provide data for required reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Drilled-Pier Standard: Comply with ACI 336.1 except as modified in this Section.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed or ASTM A996 (A996 bars from rail steel shall be Type R), 60 ksi yield, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150/C 150M, Type I/II.

a. Fly Ash: ASTM C 618, Class C or Class F.
b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregate: ASTM C 33/C 33M, graded, 3/4-inch- nominal maximum coarse-aggregate size. Provide aggregate from a single source.

1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable.

D. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
3. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
4. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.4 STEEL CASINGS

A. Steel Pipe Casings: ASTM A 283/A 283M, Grade C, or ASTM A 36/A 36M, carbon-steel plate, with joints full-penetration welded according to AWS D1.1/D1.1M.

B. Corrugated-Steel Pipe Casings: ASTM A 929/A 929M, steel sheet, zinc coated.

C. Liners: Comply with ACI 336.1.

2.5 CONCRETE MIXTURES

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 limits as if concrete were exposed to deicing chemicals.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Proportion normal-weight concrete mixture as follows:

1. Compressive Strength (28 Days): 3000 psi.
2. Maximum Water-Cementitious Materials Ratio: 0.50.
3. Minimum Slump: Capable of maintaining the following slump until completion of placement:

    a. 4 inches for dry, uncased, or permanent-cased drilling method.
    b. 6 inches for temporary-casing drilling method.

4. Air Content: Do not air entrain concrete.

2.6 REINFORCEMENT FABRICATION

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

2.7 CONCRETE MIXING

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

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

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

3.2 EXCAVATION

A. Classified Excavation: Excavation is classified as standard excavation, special excavation, and obstruction removal and includes excavation to bearing elevations as follows:

1. Standard excavation includes excavation accomplished with conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for the Work.
2. Special excavation includes excavation that requires special equipment or procedures where drilled-pier excavation equipment used in standard excavation, operating at maximum power, torque, and downthrust, cannot advance the shaft.

    a. Special excavation requires use of special rock augers, core barrels, air tools, blasting, or other methods of hand excavation.
    b. Earth seams, rock fragments, and voids included in rock excavation area are considered rock for full volume of shaft from initial contact with rock.

3. Obstructions: Payment for removing unanticipated boulders, concrete, masonry, or other subsurface obstructions that cannot be removed by conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for the Work is according to Contract provisions for changes in the Work.

B. Prevent surface water from entering excavated shafts. Conduct water to site drainage facilities.

C. Excavate shafts for drilled piers to indicated elevations. Remove loose material from bottom of excavation.

1. Excavate bottom of drilled piers to level plane within 1:12 tolerance.
2. Remove water from excavated shafts before concreting.
3. Excavate rock sockets of dimensions indicated.

D. Notify and allow testing and inspecting agency to test and inspect bottom of excavation. If unsuitable bearing stratum is encountered, make adjustments to drilled piers as determined by Architect.

1. Do not excavate shafts deeper than elevations indicated unless approved by Architect.
2. Payment for additional authorized excavation is according to Contract provisions for changes in the Work.

E. Excavate shafts for closely spaced drilled piers and for drilled piers occurring in fragile or sand strata only after adjacent drilled piers are filled with concrete and allowed to set.

F. Temporary Casings: Install watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.

1. Remove temporary casings, maintained in plumb position, during concrete placement and before initial set of concrete.

G. Tolerances: Construct drilled piers to remain within ACI 336.1 tolerances.

1. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit corrective construction proposals to Architect for review before proceeding.

3.3 STEEL REINFORCEMENT INSTALLATION

A. Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.

C. Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.

D. Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover over reinforcement.

E. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.

F. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.

3.4 CONCRETE PLACEMENT

A. Place concrete in continuous operation and without segregation immediately after inspection and approval of shaft by Owner’s independent testing and inspection agency.

1. Construct a construction joint if concrete placement is delayed more than one hour. Level top surface of concrete and insert joint dowel bars. Before placing remainder of concrete, clean surface laitance, roughen, and slush concrete with commercial bonding agent or with sand-cement grout mixed at ratio of 1:1.

B. Dry Method: Place concrete to fall vertically down the center of drilled pier without striking sides of shaft or steel reinforcement.

1. Where concrete cannot be directed down shaft without striking reinforcement, place concrete with chutes, tremies, or pumps.
2. Vibrate top 60 inches of concrete.

C. Coordinate withdrawal of temporary casings with concrete placement to maintain at least a 60-inch head of concrete above bottom of casing.

1. Vibrate top 60 inches of concrete after withdrawal of temporary casing.

D. Screed concrete at cutoff elevation level and apply scoured, rough finish. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation.

E. Protect concrete work, according to ACI 301, from frost, freezing, or low temperatures that could cause physical damage or reduced strength.

1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
2. Do not use calcium chloride, salt, or other mineral-containing antifreeze agents or chemical accelerators.

F. If hot-weather conditions exist that would seriously impair quality and strength of concrete, place concrete according to ACI 301 to maintain delivered temperature of concrete at no more than 90 deg F.

1. Place concrete immediately on delivery. Keep exposed concrete surfaces and formed shaft extensions moist by fog sprays, wet burlap, or other effective means for a minimum of seven days.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Drilled piers.
2. Excavation.
3. Concrete.
4. Steel reinforcement welding.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Drilled-Pier Tests and Inspections: For each drilled pier, before concrete placement.

1. Soil Testing: Bottom elevations, bearing capacities, and lengths of drilled piers indicated have been estimated from available soil data. Actual elevations and drilled-pier lengths and bearing capacities are determined by testing and inspecting agency. Final evaluations and approval of data are determined by Architect.

D. Concrete Tests and Inspections: ASTM C 172/C 172M except modified for slump to comply with ASTM C 94/C 94M.

1. Slump: ASTM C 143/C 143M; one test at point of placement for each compressive-strength test but no fewer than one test for each concrete load.
2. Concrete Temperature: ASTM C 1064**/**C 1064M; one test hourly when air temperature is 40 deg F and below and 80 deg F and above, and one test for each set of compressive-strength specimens.
3. Compression Test Specimens: ASTM C 31/C 31M; one set of four standard cylinders for each compressive-strength test unless otherwise indicated. Mold and store cylinders for laboratory-cured test specimens unless field-cured test specimens are required.
4. Compressive-Strength Tests: ASTM C 39/C 39M; one set for each drilled pier but not more than one set for each truck load. Test one specimen at seven days, test two specimens at 28 days, and retain one specimen in reserve for later testing if required.
5. If frequency of testing provides fewer than five strength tests for a given class of concrete, conduct tests from at least five randomly selected batches or from each batch if fewer than five are used.

6. If strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
7. Strength of each concrete mixture is satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
8. Report test results in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. List Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests in reports of compressive-strength tests.
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but not be used as sole basis for approval or rejection of concrete.
10. Additional Tests: Testing and inspecting agency to make additional tests of concrete if test results indicate that slump, compressive strengths, or other requirements have not been met, as directed by Architect.

    a. Continuous coring of drilled piers may be required, at Contractor's expense, if temporary casings have not been withdrawn within specified time limits or if observations of placement operations indicate deficient concrete quality, presence of voids, segregation, or other possible defects.

11. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. An excavation, concrete, or a drilled pier will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports for each drilled pier as follows:

1. Actual top and bottom elevations.
2. Actual drilled-pier diameter at top and bottom.
3. Top of rock elevation.
4. Description of soil materials.
5. Description, location, and dimensions of obstructions.
6. Final top centerline location and deviations from requirements.
7. Variation of shaft from plumb.
8. Shaft excavating method.
9. Design and tested bearing capacity of bottom.
10. Depth of rock socket.
11. Levelness of bottom and adequacy of cleanout.
12. Ground-water conditions and water-infiltration rate, depth, and pumping.
13. Description, purpose, length, wall thickness, diameter, tip, and top and bottom elevations of temporary or permanent casings. Include anchorage and sealing methods used and condition and weather tightness of splices if any.
14. Description of soil or water movement, sidewall stability, loss of ground, and means of control.
15. Date and time of starting and completing excavation.
16. Inspection report.
17. Condition of reinforcing steel and splices.

18. Position of reinforcing steel.
19. Concrete placing method, including elevation of consolidation and delays.
20. Elevation of concrete during removal of casings.
21. Locations of construction joints.
22. Concrete volume.
23. Concrete testing results.
24. Remarks, unusual conditions encountered, and deviations from requirements.

3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 31 63 29

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Hot-mix asphalt patching.
2. Hot-mix asphalt paving.
3. Asphalt surface treatments.
4. Pavement-marking paint.

B. Related Sections:
1. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.
2. Division 32 Sections for other paving installed as part of crosswalks in asphalt pavement areas.

1.3 DEFINITION

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.4 SUBMITTALS

A. Material Certificates: For each paving material, from manufacturer.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the Ohio Department of Transportation for asphalt paving work.
1. Measurement and payment provisions and safety program submittals included in standard DOT specifications do not apply to this section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Comply with weather limitations as per the Ohio Department of Transportation Construction and Material Specifications.
2. Tack Coat: Comply with weather limitations as per the Ohio Department of Transportation Construction and Material Specifications.
3. Asphalt Base Course: Comply with weather limitations as per the Ohio Department of Transportation Construction and Material Specifications.
4. Asphalt Surface Course: Comply with weather limitations as per the Ohio Department of Transportation Construction and Material Specifications.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, and 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications as indicated on the plans.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications as indicated on the plans.

B. Asphalt Cement: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications as indicated on the plans.

C. Prime Coat: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications.

D. Tack Coat: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications as indicated on the plans.

E. Water: Potable.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Paving Geotextile: As specified on plans.

C. Joint Sealant: ASTM D 6690 or AASHTO M 324, Type II or III, hot-applied, single-component, polymer-modified bituminous sealant.

D. Pavement-Marking Paint: ODOT Item 642.

1. Color: Match existing striping colors.

2.4 MIXES

A. Hot-Mix Asphalt: Use plant-mixed, hot-laid asphalt aggregate mixtures complying with the Ohio Department of Transportation Construction and Materials Specifications as indicated on the plans.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
1. Proof rolling to be performed in presence of Architect or Engineer.
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, Engineer, or Geotechnical Engineer, and replace with compacted backfill or fill as directed.

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

D. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of asphalt.

3.2 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove all soft or unsatisfactory material. Recompact subgrade and any existing unbound-aggregate base course to form new subgrade.

B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting against new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

C. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.3 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/2 inch.

1. Clean cracks and joints in existing hot-mix asphalt pavement.
2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.4 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd.. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.5 PAVING GEOTEXTILE INSTALLATION

A. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches and transverse joints 6 inches.

1. Protect paving geotextile from traffic and other damage and place next portion of the pavement section the same day.

3.6 HOT-MIX ASPHALT PLACING

A. Asphalt shall be placed in accordance with the Ohio Department of Transportation Construction and Material Specifications and as indicated on the plans.

B. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at minimum temperatures as per the Ohio Department of Transportation Construction and Material Specifications.
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

C. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

D. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.7 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints Per ODOT standards.
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.8 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction within temperature specifications as set in the Ohio Department of Transportation Construction and Materials Specifications.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927, but not less than 94 percent nor greater than 100 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.9 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch (total of all combined base courses).
2. Surface Course: Plus 1/4 inch, no minus.
3. Total Thickness: Where total thickness is of asphalt material is 3” or less, total pavement thickness is to be plus or minus 1/4 inch.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.
2. Surface Course: 1/8 inch.

3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.10 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age per manufacturers recommendations before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply per ODOT 642 Specifications to a minimum wet film thickness of 20 mils.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner is to engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

    a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
    b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

E. Replace and compact hot-mix asphalt where core tests were taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.12 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow milled materials to accumulate on-site.

END OF SECTION 321216

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes exterior cement concrete pavement for the following:
   1. Curbs and gutters.
   2. Walkways.

B. Related Sections include the following:

   1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
   2. Division 31 Section "Earth Moving" for subgrade preparation, grading, and subbase course.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

A. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:

   1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

C. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:

   1. Cementitious materials.
   2. Admixtures.
   3. Curing compounds.
   4. Applied finish materials.

D. Jointing Plan

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.

C. ACI Publications:
1. Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.
2. Comply with ACI 330, "Guide for Design and Construction of Concrete Parking Lot" unless modified by requirements in the Contract Documents.
3. Comply with ACI 325, " Design of Jointed Concrete Pavements for Streets and Local Roads" unless modified by requirements in the Contract Documents.

D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1. Before submitting design mixtures, review concrete pavement mixture design and examine procedures for ensuring quality of concrete materials and concrete pavement construction practices. Require representatives, including the following, of each entity directly concerned with concrete pavement, to attend conference:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete producer.
d. Concrete pavement subcontractor.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

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 Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.

1. Use flexible or curved forms for curves with a radius 100 feet or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

B. Epoxy-Coated Welded Wire Fabric: ASTM A 884/A 884M, Class A, plain steel.

C. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.

D. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.

E. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.

F. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain steel bars.

G. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

H. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

I. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

J. Epoxy Repair Coating: Liquid two-part epoxy repair coating, compatible with epoxy coating on reinforcement.

K. Zinc Repair Material: ASTM A 780.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use one of the following cementitious materials, of the same type, brand, and source throughout the Project:

1. Portland Cement: ASTM C 150, Type I., gray. Supplement with the following:

a. Fly Ash: ASTM C 618, Class F.
b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, Class 4S coarse aggregate, uniformly graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar pavement applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 1 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material when steel reinforcement is called out in exterior installations.

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

2.5 FIBER REINFORCEMENT

A. Synthetic Fiber: Monofilament polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.

2.6 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. Dry, delivered pre-wetted and soaked.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

2.7 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM 1752 Vinyl full depth, with joint sealant.

2.8 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 4000 psi, unless otherwise indicated on the drawings.
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
3. Slump Limit: 3 inches, or up to 5 inches with the use of a water-reducing chemical admixture.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
1. Air Content: 6 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

F. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements and as follows:

1. Fly Ash or Pozzolan: 25 percent.
2. Ground Granulated Blast-Furnace Slag: 50 percent.

3. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 25 percent.

G. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd..

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades
1. Proof rolling to be performed in presence of Architect or Engineer.
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, Engineer, or Geotechnical Engineer, and replace with compacted backfill or fill as directed.

C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain 2” minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

F. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.

1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, or through locations of intended contraction or isolation joints, unless otherwise indicated.
2. Provide tie bars at sides of pavement strips where indicated.
3. Doweled Joints: Install dowel bars and support assemblies at joints where indicated, or when construction joint will experience heavy truck traffic . Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint. Dowels to be epoxy coated and sized per ACI 330.

C. Isolation (expansion) Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of not more than 30 feet, unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.

4. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
5. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
6. Apply joint sealant / caulk.
7. Doweled Joints: Install dowel bars and support assemblies at joints where indicated, or when construction joint will experience heavy truck traffic . Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint. Dowels to be epoxy coated and sized per ACI 330.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. For thickness 5 inches or less construct contraction joints for a depth equal to at least one-third of the concrete thickness, for thickness greater than 5 inches construct contraction joints for a depth equal to at least one-quarter of the concrete thickness, as follows or match jointing of existing adjacent concrete pavement:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated, or when construction joint will experience heavy truck traffic . Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint. Dowels to be epoxy coated and sized per ACI 330.

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed if plastic shrinkage cracking is of concern.

D. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

E. Comply with ACI 301 and ASTM C94, requirements for measuring, mixing, transporting, and placing concrete.

F. A one time add of water to concrete during delivery or at Project site is permitted but the water to cementitious material ratio must not be violated.

G. Do not add water to fresh concrete after testing.

H. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

I. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

J. Screed pavement surfaces with a straightedge and strike off.

K. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

L. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.

M. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.

N. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

O. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.

P. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature,

provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated prior to placement and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall

within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.9 TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

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

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least 1 composite sample for each 5000 sq. ft. or fraction thereof of each concrete mix placed each day.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.

    a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.11 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321813 – SYNTHETIC INFILL ATHLETIC TURF

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. Furnish all labor, materials, tools and equipment necessary to install all artificial athletic turf as indicated on the plans and as specified herein. The installation of all new materials shall be performed in strict accordance with the manufacturer's installation instructions and in accordance with all approved shop drawings.
2. Indoor running strip (8' wide) within the new Strength & Conditioning facility.

B. Related Sections:

1.2 DEFINITIONS

A. Subgrade: surface of subsoil remaining after site excavation, or top surface of a fill or backfill above which the field's gravel foundation is installed.
Turf Manufacturer: company that tufts the synthetic turf carpet
B. Turf Contractor: company that bids this project, executes the Contract and installs the field.
C. Gmax: measure of surface hardness using the ASTM F 355 -95 Standard Test Method for Shock-Absorbing Properties of Playing Surface Systems and Materials.

1.3 REFERENCES

A. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition

B. ASTM Standard Test Methods:

1. D1577 - Standard Test Method for Linear Density of Textile Fiber
2. D5848 - Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Covering
3. D418 - Standard Test Method for Testing Pile Yarn Floor Covering Construction
4. D1338 - Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings
5. D1682 - Standard Method of Test for Breaking Load and Elongation of Textile Fabrics
6. D5034 - Standard Test Method of Breaking Strength and Elongation of Textile Fabrics (Grab Test)
7. F1015 - Standard Test Method for Relative Abrasiveness of Synthetic Turf Playing Surfaces
8. D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity
9. D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials
10. F355 - Standard Test Method for Shock-Absorbing Properties of Playing Surfaces.
11. F1936 - Standard Test Method for Shock-Absorbing Properties of North American Football Field Playing Systems as Measured in the Field
12. D1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

1.5 PERFORMANCE REQUIREMENTS

A. Synthetic grass system shall comply with the following ASTM performance requirements:

Standard	Property	Specification
ASTM D1577	Fiber Denier	> 8,000 nominal
ASTM D418/D5848	Pile Height	< 2.25" or equal
ASTM D418/D5848	Pile Weight	> 33 oz./sq. yd. or equal
	Total Weight	> 53 oz./sq. yd. or equal
ASTM D1335	Tuft Bind	> 6 lbs. (without infill)
ASTM D1335	Tuft Bind	> 12 lbs. (with infill)
ASTM D1682/D5034	Grab Tear (width)	207 lbs/force
ASTM D1682/D5034	Grab Tear (length)	297 lbs/force
ASTM F1015	Relative Abrasiveness Index	14.45
ASTM D4491	Carpet Permeability	12 inches/hour
ASTM D2859	Flammability (Pill Burn)	Pass
ASTM F355/F1936	Impact Attenuation, Gmax	= >80 and < 130 at installation = < 175 over field life (sand/rubber)

1.6 SUBMITTALS

A. Bidding Submittals: Contractor shall provide the following documentation as part of the post-bid evaluations to be performed with the apparent lowest, most responsible Contract bidder(s):

1. No Patent Violation Documentation: The Manufacturer shall specify in writing that their turf system does not violate any other manufacturer's patents, patents allowed or patents pending. The Manufacturer shall provide documentation indemnifying the Owner, A/E, and any Engineering Sub-consultants from any legal action arising from said patent disputes should the Owner enter into a Contractual relationship with Manufacturer. This documentation SHALL BE SIGNED AND NOTARIZED at the time of the shop drawing submittal.
2. Contractor Qualifications: The Contractor must include the Bidder & Product Information documentation listed in Division 0 Procurement and Contracting Requirements for review by the Owner.
3. Testing and Quality Control: the Contractor shall submit a copy of the results certified by an independent (third party) testing laboratory for all tests performed on the synthetic grass system offered and indicate the applicable ASTM standard as referenced in Part 1.5 Performance Requirements.
4. Loss of Tensile Strength Warranty: The Contractor shall submit a description of the parameters regarding warranty against loss of tensile strength, specifying acceptable percentages of tensile strength loss on an annual basis and across the life of the warranty.
5. The Contractor must submit the carpet and fiber manufacturer's name, type of fiber and composition of fiber. Contractor shall certify that all fiber is from a single-source and is of the same polymer and the same dye lot. Testing by a FIFA approved laboratory to be submitted showing yarn wear using a lisport machine after a minimum 40,000 cycles.
6. A letter and specification sheet: The Contractor shall certify that the products of this section meet or exceed specified requirements.
7. Synthetic Turf Bidder and Product Information Evaluation Form
8. Resume of installation crew supervisor: Identify who will be present on site during installation.

a. Include three (3) to five (5) full-sized field installations in the United States constructed in the last 36 months of the exact specified material, including the infill material and fiber. Refer to section 1.7.B.

9. List of existing identical installations in the NCAA or professional sports leagues, including Owner's representative and telephone number, constructed in the last 36 months.

    a. Three (3) to five (5) full-sized fields in the United States of the exact specified material, including the infill material and fiber.
    b. These installations must have used the same manufacturer, product and company that are proposed for this field.

B. Construction Submittals: Prior to the ordering of materials, the Contractor shall submit the following documentation:

1. Product Data: For each type of product indicated. Include construction details and material descriptions.
2. Shop Drawings indicating:

    a. Roll/Seaming Layout
    b. Methods of attachment, perimeter concrete curb conditions.
    c. Details of system construction, including all details that deviate from the Contract Documents.

3. Test data and/or cut sheets for the following:

    a. Perimeter termination concrete curb.
    b. Synthetic turf fiber.
    c. Infill material analysis.
    d. Crumb rubber analysis, sand analysis.

4. Contractor must submit product data sheets in compliance with Alternate 1.2.7 should this Alternate be accepted.

5. Samples for Initial Selections: For each type of material indicated.

    a. Two (2), 24 x 24 inch in size (approx) turf samples, illustrating details of finished product and range at tuft, line and graphic colors, as well as complete infill installation with proper mix ratio, one pound sample.

6. Engineering calculations that demonstrate the field system has the capacity to meet the drainage requirements listed in Section 1.6. Include movement of water through the carpet, gravel base and drainage lines. The proposed field design shall not exceed a slope of 0% from the longitudinal centerline to the edges of the field surface.

7. A copy of the maintenance guidelines and operating data for synthetic turf system. Provide descriptions of all equipment recommended for maintenance and repair, including that to be provided by the successful Contractor and by the Owner. List activities to avoid in order to protect the turf system. Include maintenance recommendations such as coverings for special events.

C. Prior to Final Acceptance, the Contractor shall submit to the Owner:

1. Three (3) copies of Maintenance Manuals, which will include all necessary instructions for the proper care and preventative maintenance of the synthetic turf system, including painting and markings.
2. Project Record Documents: Record actual locations of seams, drains or other pertinent information.
3. Field Guarantee Documentation.
4. Certified Engineering Drawing: Provide as-built construction drawing stamped and certified by Registered Civil Engineer outlining elevation points to verify that field was constructed to the grade elevations as shown on the Contract Documents within the tolerances outlined within this section for Owner approval and that the field dimensions are accurate with respect to OHSAA guidelines.
5. Warranties: Sample of special warranties.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section. The Turf Contractor and/or the Turf Manufacturer:

1. Must be experienced in the manufacture and installation of this specific type of synthetic infill grass system with the same manufacturer, product and company they are proposing for this field. This includes the tuft fiber, the backing, the backing coating, and the installation method.
2. Shall have manufactured (tufted) more than fifteen million (15,000,000) square feet of PE tufted turf for sports field use in the past five (5) years.

B. Contractor /Installer Qualifications: Company specializing in performing the Work of this section.

1. The Contractor must provide competent workmen skilled in this specific type of synthetic grass installation.
2. The designated Supervisory Personnel on the project must be certified, in writing by the turf Manufacturer, as competent in the installation of this material, including sewing seams and proper installation of the infill mixture.
3. The Contractor shall have a representative on site to certify the installation and Warranty compliance.
4. Shall have been in the sports field construction and/or synthetic turf installation business, under the same ownership, for at least five (5) years.
5. Have installed a minimum of thirty (30) full-sized synthetic turf fields with similar characteristics, within the past five (5) years.
6. Turf Contractor shall be approved in writing by the turf manufacturer and trained in the installation of the synthetic infill turf systems.
7. Shall be a certified member of the Synthetic Turf Council (STC) and a member of the Sports Turf Managers Association (STMA).

C. The Turf Contractor shall provide the necessary testing data to the owner that the finished field meets the required shock attenuation, as per ASTM F1936.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Deliver products to project site in wrapped condition.

B. Store products under cover and elevated above grade.

C. The Contractor shall supply the owner with 100 lineal feet of carpet, 1,000 lbs. of infill material and one 5-gallon pail of seaming glue at the end of the project.

1.9 WARRANTIES

A. A Workmanship Installer Warrantee shall be provided for a minimum period of eight (8) years after the date of Substantial Completion. This shall warrant against all defects in the workmanship including the gravel foundation, drainage and synthetic turf surface. This includes, but is not limited to, gravel base stability, differential settlement, drainage rates and seaming of materials and adhesives/stitching.

B. Field Guarantee shall cover, in general, the usability of the turf and shock/underlayment pad systems (if required by the manufacturer's system); accessories use characteristics and suitability of the installation. The term of the Field Guarantee will be for a period of a minimum of eight (8) years after the date of Substantial Completion, unless the successful Contractor proposes and agrees to a longer period. By submitting its Bid, each Contractor agrees to be bound by the Field Guarantee. This Field Guarantee is for the benefit of the Owner and may be enforced by the Owner.

C. As part of the Field Guarantee, the successful Contractor warrants to the Owner that its synthetic grass materials shall not fade, fail, shrink, wrinkle or exhibit excessive wear, and that its Work will be in accordance with these Specifications and free from defects. Weather permitting, the successful Contractor, at its sole expense and cost, shall correct any failure to comply with the Field Guarantee within thirty (30) days after notice is given. The Owner will give such written notice within thirty (30) days after discovering such failure. If the successful Contractor fails to take such corrective action, the Owner may take such action, and the successful Contractor will reimburse the Owner for all related costs incurred by the Owner in doing so.

D. Definitions

1. The term "not fade" in the context of this warranty shall mean that the synthetic grass material shall maintain a uniform shade of green (or the other colors installed) with no significant disparity in loss of color across the full system, as defined by a loss not greater than 20% in shade reduction.
2. The terms "not fail" or "excessive wear", as used in the context of the Field Guarantee shall mean loss of yarn (length and weight) according to ASTM D418. As part of its submittals, the successful Contractor must supply the Owner specific parameters regarding acceptable percentage loss of yarn. The synthetic turf materials will meet these parameters throughout the life of the warranty.
3. The term "serviceable" in the context of this warranty shall mean that the synthetic turf material shall have a G-max value according to Procedure A, B, or C of ASTM D355, of not less than 80 and not more than 130 at thirty (30) days after installation of the system and not more than 175 over the life of the warranty. Additionally, increases in G-max shall not exceed an increase of 10 G's in any single year with proper grooming as recommended by the Contractor.

E. The fabric shall adhere firmly and completely to the seaming glue.

F. The Field Guarantee shall not limit the amount or hours of use for athletic, extracurricular, or other activities on the final field by the Owner during the terms of the warranty.

G. The successful Contractor shall not be held responsible for any incidental or consequential damages. The Field Guarantee is subject to:

1. The Owner notifying the Contractor of failures that needs to be repaired or replaced within five (5) days of identifying such failures. The Contractor shall be required to make

ALL repairs, whether major or minor, to the synthetic grass system during the first year of the Field Guarantee. If the failures are deemed to be due to failures in materials or workmanship, the Contractor shall make the repairs at no cost to the Owner. During the remaining eight (8) years of the Field Guarantee, the Owner shall make all minor repairs to the synthetic grass system promptly upon discovery of the need for such repairs.

2. The successful Contractor shall inspect the field system 8-9 months, or as directed by the Owner, from the date of completion for uniformity of the rubber infill material and at no cost to the Owner shall groom and make any additions; distributions or removal of infill material necessary to assure the infill is at a uniform height and density across the entire field system.
3. The Owner maintaining and properly caring for the synthetic grass system in accordance with the successful Contractor's maintenance manual and use instructions. The successful Contractor shall provide such manual and instructions to the Owner before Substantial Completion.
4. The Owner complying with the dynamic and static load specifications provided by the successful Contractor provided they are consistent with these Specifications.
5. The Field Guarantee does not cover any defect, failure, damage or undue wear in or to the synthetic grass system caused by or connected with:

   (a) Abuse, neglect.
   (b) Deliberate acts.
   (c) Acts of God.

6. Casualty, static or dynamic loads exceeding successful Contractor's specifications provided by the successful Contractor; provided they are consistent with these Specifications.
7. Use of footwear having metal cleats, spikes or similar metal projections, other than conventional baseball, football, soccer or rugby shoes having cleats of > 3/4" in length and other conventional running shoes having spikes of not more than 1/2" in length.
8. Use of improper cleaning methods.
9. Improper treatment such as excessive vehicular traffic, use of vehicles with anything other than smooth tread, pneumatic tires, use of golf clubs, fireworks, concerts, and other improper uses.

H. As part of its Contract price and without additional compensation, at the completion of the infill turf installation, at the end of years one (1), four (4) and at the end of the Field Guarantee (year eight (8)), the successful Contractor will perform a 3rd party field hardness tests in accordance with the ASTM D355 standard to determine whether the grass system is meeting these Specifications. Such testing will be scheduled with the Owner. The successful Contractor will provide the test results to the Owner within thirty (30) days after the completion of the testing. If the grass system does not meet these Specifications, the successful Contractor will remedy the non-conformity within an additional thirty (30) days.

I. The Owner understand that the successful Contractor will not be giving any warranties other than the Field Guarantee and Workmanship Guarantee, and that no warranties as to merchantability or fitness for a particular purpose, are made with respect to the subject matter hereof, and that in no event shall the successful Contractor be held liable for any incidental or consequential damages.

J. If the successful Contractor does not comply with its obligations under the Field Guarantee and Workmanship Guarantee, the Owner’s exclusive remedy shall be the reasonable cost of repairing or replacing the part of the Work that does not conform to the Field Guarantee, and any related testing or investigation costs.

1.10 MAINTENANCE SERVICE

A. The Turf Contractor will train the Owner's facility maintenance staff in the use of the turf Manufacturer's recommended groomer. In addition, this training shall be repeated during a required 8-9 month follow-up inspection (scheduled by Owner).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Pre-approved manufacturers by the Owner are as follows:

1. **AstroTurf** - GameDay Grass XPE 42
2. **The Motz Group** - Twenty-Four/Seven 40 oz.
3. **FieldTurf** - FieldTurf Classic

B. Infill products are as follows:

1. Infill to be comprised of combination crumb rubber and approved sand. Bidders are to include a minimum of 30 percent sand (by weight).

2.2 MATERIALS

A. The component materials of the artificial grass athletic turf system consist of:

1. A carpet made of polyethylene fibers tufted into a fibrous, porous backing.
2. An Infill that is a controlled mixture of graded sand, compatible with Manufacturer’s turf system, and/or rubber crumb.
3. Glue, thread, seaming fabric and other materials used to install and mark the artificial athletic turf.

B. The Carpet shall consist of fibers tufted into a primary backing with a secondary backing.

1. The Carpet shall be furnished in 15’ wide rolls. Rolls shall be long enough to go from sideline to sideline without splicing. The perimeter white line shall be tufted into the individual sideline rolls. Head seams, other than at sidelines, will not be acceptable
2. The Carpet’s primary backing shall be a minimum two-part polyethylene fabric treated with UV inhibitors. The secondary backing shall consist of an application of porous, heat-activated 20 oz. min. urethane to permanently lock the fiber tufts in place. Machine gauge shall be 3/8” – 3/4”. Backing perforations shall be a minimum of 3/8” diameter spaced a minimum of 4”x4” O.C. capable of meeting drainage requirements.
3. The fiber shall be parallel slit-filament type, low friction, and UV-resistant. Acceptable products include:

    a. Tencate Tapeslide XP/XP Oro
    b. Strenexe
    c. FieldTurf XT
    d. Polytex Wearmaxx

4. The fiber tufts shall be fanned or unfolded prior to installation, rolling or spiraling is not acceptable.

C. Infill: The synthetic carpet shall be filled with cryogenically or ambient ground, recycled rubber, or EPDM. The infill shall include a percentage of approved sand per the Contractor’s

system requirements for an infill blend (or as required by Owner). Spread the infill uniformly into the carpet in lifts to assure a consistent depth.

1. Sieve size requirement for rubber infill material: #10 minimum/#14 maximum.

D. Thread for sewing seams of turf shall be as recommended by the synthetic turf Manufacturer.

E. Glue and seaming fabric for inlaying lines and markings shall be as recommended by the synthetic turf Manufacturer.

2.3 MAINTENANCE EQUIPMENT

C. The Turf Contractor shall provide the Owner with one (1) grooming-type brush for use by Owner's equipment. Groomer design as recommended by the synthetic turf system manufacturer for proper maintenance of the synthetic turf system, and to satisfy and maintain the warranty requirements as described in this specification. The groomer shall be of sufficient size to cover a minimum six-foot (6') wide swath in a single pass.

PART 3 - EXECUTION

3.1 GENERAL

A. The installation shall be performed in full compliance with these specifications and approved Shop Drawings.

B. Only trained technicians, skilled in the installation of athletic caliber synthetic turf systems working under the direct supervision of the approved installer supervisors, shall undertake any cutting, sewing, gluing, shearing, and topdressing or brushing operations.

C. The designated Supervisory personnel on the project must be certified, in writing by the turf Manufacturer, as competent in the installation of this material, including sewing seams and proper installation of the Infill mixture.

3.2 EXAMINATION

A. NOTE: At the completion of the sub-base Work, the Turf Installer shall provide a topographical survey by a registered surveyor illustrating the sub-base is flat for approval by the installer, prior to commencing with the installation of the infill turf.

B. The Turf Contractor shall have the dimensions of the field and locations for markings measured by a registered surveyor to verify conformity to the specifications and applicable standards. A record of the finished field as-built measurements shall be made.

C. The compaction of the aggregate base shall be 95%, according to the Modified Proctor procedure (ASTM D1557), and the surface tolerance shall not exceed 1/8 inch over 10 feet and 1/2" from design grade. The field's finished surface shall be flat and within these tolerances.

3.3 INSTALLATION

A. Install in accordance with Manufacturer's instructions. The Turf Contractor shall strictly adhere to the installation procedures outlined under this section. Any variance from these requirements must be accepted in writing, by the Manufacturer's on-site representative, and submitted to the A/E/Owner, verifying that the changes do not in any way affect the Warranty.

Infill materials shall be approved by the Manufacturer and installed in accordance with the Manufacturer's standard procedures.

B. The carpet rolls are to be installed directly over the properly prepared aggregate base. Extreme care should be taken to avoid disturbing the aggregate base, both in regard to compaction and planarity.

C. The full width rolls shall be laid out across the field. Turf shall be of sufficient length to permit full cross-field installation from sideline to sideline. No head or cross seams will be allowed in the main playing area between the sidelines. Utilizing standard state of the art sewing and gluing procedures each roll shall be attached to the next. When all of the rolls of the playing surface have been installed, the sideline areas shall be installed at right angles to the playing field turf.

D. Seaming: The infill carpet panels shall be double stitched. All seams shall lie perfectly flat, without discernible ridges, bumps or voids in the fibrillated tufts at the playing surface grater than the stitch gauge of the carpet. All seams shall be warranted against separation or tearing for the life of the system.

E. Infill materials shall be applied in numerous thin lifts per the Manufacturer's requirements. The turf shall be brushed as the mixture is applied. The infill material shall be installed to a depth determined by the Manufacturer.

F. The Infill materials shall be installed to fill the voids between the fibers and allow the fibers to remain vertical and non-directional.

G. Synthetic turf shall be attached to the perimeter edge wood nail board in accordance with the Manufacturer's standard procedures.

3.5 CLEANING

A. Protect installed turf surface from subsequent construction operations.

B. Do not permit traffic over unprotected turf surface.

C. Contractor shall provide the labor, supplies, and equipment as necessary for final cleaning of surfaces and installed items.

D. All usable remnants of new material shall become the property of the Owner.

E. The Contractor shall keep the area clean throughout the project and clear of debris.

F. Surfaces, recesses, enclosures, etc., shall be cleaned as necessary to leave the Work area in a clean, immaculate condition ready for immediate occupancy and use by the Owner.

END OF SECTION 321813

SECTION 329113 – PLANTING SOILS

PART 1 - GENERAL

1.1 GENERAL PROVISION

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

1.2 SUMMARY

A. The work of this Section consists of providing all labor, equipment, materials, incidental work, and construction methods necessary to provide and place planting soils as indicated on the Contract Documents and as specified in this Section

1. Mixing, amending and manufacturing planting soils from base components.
2. Soil testing.
3. Placing, spreading and grading of planting soil.

1.3 RELATED SECTIONS

A. The following items of related work are specified and included in other Sections of the Specifications:

1. Section 329200 "Turf and Grasses" for turf mix and installation.
2. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants.

1.4 DEFINITIONS

A. Planting Soils: The lawn and planting soils consist of a blend of natural topsoil without admixture of subsoil, stripped from the project site, and organic material. Do not mix subsoil with topsoil. The existing topsoil stripped from the Site requires testing after stockpiling to determine the proportion of soil amendments required to meet Specification Requirements.

1. Base Components:

a. Base topsoil is a natural growing medium, either stripped from the Site or from other off-site sources.
b. Uniform Sand is uniformly graded medium to coarse Uniform Sand.
c. Organic Material is fully decomposed organic material.

1.5 SUBMITTALS

A. At least 30 days prior to ordering materials, the Contractor shall submit to the Architect representative samples, certifications, manufacturer's product data and certified test results for

materials as specified below for approval. No materials shall be ordered or delivered until the required submittals have been reviewed and approved by the Architect. Delivered materials shall closely match the approved samples. Approval shall not constitute final acceptance. The Architect reserves the right to reject, on or after delivery, any material that does not meet these specifications.

B. Topsoil:

1. Existing On-Site Topsoil: Sample and test existing on-site topsoil.
2. The Contractor shall provide a one cubic foot representative sample per each 1,000 cubic yard on-site stockpile of existing topsoil for testing. All stockpile sampling shall be per ASTM D 75 and Appendixes for securing samples from stockpiles.
3. Testing will be at the Contractor's expense. Contractor shall deliver all samples to testing laboratories via overnight courier and shall have the testing report sent directly to the Architect. Perform all tests for gradation, organic content, soil chemistry and pH by CLC Labs, 325 Venture Drive, Westerville, OH 43081; (615) 888-1663.
4. Testing reports shall be dated within 30 days of submission to the Architect. Testing reports beyond 30 days old will be rejected and new testing reports mandated.
5. Testing reports shall include the following tests and recommendations. Contractor shall deliver samples to testing laboratories and shall have the testing report sent directly to the Architect from the testing agency. Testing reports shall include the following tests and recommendations.

    a. Mechanical gradation (sieve analysis) shall be performed and compared to the USDA Soil Classification System. Sieve analysis shall be by combined hydrometer and wet sieving using sodium hexametaphosphate as a dispersant in compliance with ASTM D 422 after destruction of organic matter by H_2O_2. To facilitate review and approval of sieve analysis, provide a computer generated gradation curve from testing agency.
    b. Percent of organics shall be determined by the loss on ignition of oven-dried samples. Test samples minus #10 material shall be oven-dried to a constant weight at a temperature of 450 degrees Fahrenheit (752 degrees Centigrade).
    c. Chemical analysis shall be undertaken for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, extractable Aluminum, Lead, Zinc, Cadmium, Copper, Soluble Salts, and pH and buffer pH. A Conductivity Meter shall be used to measure Soluble Salts in 1:2 soil/water (v/v). Except where otherwise noted, nutrient tests shall be for available nutrients.
    d. Soil analysis tests shall show recommendations for soil additives to correct soils deficiencies as necessary, and for additives necessary to accomplish turf and planting work as specified.

C. Soil amendments:

1. Submit

    a. Acidulant: Submit supplier’s certification that the acidulant being supplied conforms to these specifications.
    b. Fertilizer: Submit product data of seeding and planting fertilizer and certificates showing composition and analysis. Submit fertilization rates for fertilizer product based upon soil testing, analysis, and recommendations.

2. Tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422 after destruction of organic matter by ignition.

3. Test for agricultural suitability analysis including: Particle size and characteristics, and pH.

1.6 EXAMINATION OF CONDITIONS

A. The Contractor shall be solely responsible for judging the full extent of work requirements involved, including but not limited to sampling and testing of on-site stockpiles of delivered off-site loam borrow prior to final planting installation.

1.7 SITE CONDITIONS

A. Soil Moisture Content

1. Contractor shall not move, blend or grade soil when moisture content is so great that adequate mixing is not possible, nor when it is so dry that dust will form in the air or that clods will not break readily, nor when it is frozen. Apply water, if necessary, or allow soil to dry to bring soil moisture between 60% of optimum moisture content and optimum moisture content as determined by ASTM D698 for compaction, grading and plantings.
2. Soil may not be manipulated in any way while in a wet condition, including moving of stockpiles, grading, planting or any other excavation. Contractor is responsible for removal and replacement of any and all soils that were manipulated when wet.
3. Field Soil Moisture Test

    a. Form soil in palm of hand, if soil retains shape and crumbles upon touching, the soil may be worked.
    b. If the soil will not retain shape it is too dry and should not be worked.
    c. If the soil retains shape and will not crumble, it is too wet and should not be worked.
    d. If the soil glistens or free water is observed when the sample is patted in the palm of hand the soil is too wet and should not be worked.

PART 2 - PRODUCTS

2.1 TOPSOIL – GENERAL

A. On-site Soils

1. Topsoil stockpiled from on-site stripping shall be utilized for reuse.
2. Amend all topsoil on site by mixing with sand and compost to manufacture specified soil mixes.

B. Additional topsoil:

1. In the event that there is an insufficient amount of on-site topsoil to complete the project, additional topsoil from off-site sources shall be provided for mixing with sand and compost to manufacture the specified soil mixes. Any amendments used to manufacture a soil to be imported shall meet the specifications defined in this section.

2.2 AMENDED TOPSOIL FOR GENERAL USE

A. The on-site soil or any imported topsoil shall be amended with the specified sand or compost to produce a soil meeting the following criterion, as determined by ASTM F1632 or D422:

1. Sand: (0.05 to 2.0 mm) 65 – 75% with at least 50% of the total sand falling into the medium and coarse sand fractions and no more than 25% of the total sand in the fine and very fine sand fractions.
2. Silt: (0.002 to 0.05 mm) 15 - 25%
3. Clay: (< 0.002) 5 - 15%
4. Gravel: (> 2.0 mm) < 15%
5. Maximum size shall be three eights (3/8") inches largest diameter.

For bidding purposes, topsoil, sand and compost, each as specified in this Section, shall be combined in an approximate mix ratio of 1 part by volume of sand to one part by volume of on-site topsoil to one part by volume of compost (1S:1TS:1C). Final mix ratios to be determined by the Contractor and shall meet the requirements of this Section.

B. The amended soil shall have an organic matter content of 4 to 6% (by weight) as determined by ASTM F1647. For bidding purposes, the amount of compost required to increase the organic matter content to meet the specifications can range from 30 to 50% by volume, depending on the quality of the compost.

C. Ratio of the particle size for 80% passing (D_{80}) to the particle size for 30% passing (D_{30}) shall be 5.5 or less. (D_{80}/D_{30} <8)

D. The amended soil shall have a minimum percolation rate of 0.50-inch per hour with the soil compacted to 88% of maximum standard proctor density (ASTM D698).

E. The topsoil meeting this specification shall serve as the baseline for subsequent quality control testing. Samples shall be taken every 1000 yards prior to placement on the lawn area for conformity to the specifications. Quality control testing shall include organic matter content and particle size analysis.

F. The final soil mix shall be submitted to testing agency to determine the fertility status of the soil.

2.3 SOIL ADDITIVES

A. General: Soil additives shall be used to counteract soil deficiencies as recommended by the soils analysis and as supplements for turf construction as specified herein.

B. Acidulant for adjustment of loam borrow pH shall be commercial grade flours of sulfur, ferrous sulfate, or aluminum sulfate that are unadulterated. Acidulants shall be delivered in unopened containers with the name of the manufacturer, material, analysis and net weight appearing on each container.

C. Ground limestone for adjustment of loam borrow pH shall contain not less than 85 percent of total carbonates and shall be ground to such fineness that 40 percent will pass through 100 mesh sieve and 95 percent will pass through a 20 mesh sieve. Contractor shall be aware of loam borrow pH and the amount of lime needed to adjust pH to meet the requirements of the testing lab recommendations.

D. The compost used to amend the soil shall be well decomposed, stable, mature, aerobically composted product utilizing feedstock from yard wastes, food wastes, biosolids, or any combination of these. The compost shall meet the following criteria:

1. An organic matter content of no less than 35% as determined by ASTM D2974.
2. A moisture content of 35 – 70%, as determined by ASTM D2974.
3. A carbon/nitrogen ratio of 15:1 to 30:1.
4. Soluble salts not to exceed 2 dS/m.
5. A Solvita Index of 5 to 8.
6. 95 – 100% passing a 3/8" screen.
7. A pH of 6 to 8.
8. Non-phytotoxic.
9. All EPA and state regulations for biosolid composts.

The Contractor shall submit representative samples of organic matter amendment they intend to bring onto the site to the owners testing agent. All reports shall be sent to the Architect for approval.

E. Sand shall be blended into the topsoil in the proper amount to achieve the particle size distribution described in these specifications. Sand for use as a soil amendment shall be a washed natural or classified sand meeting the following particle size distribution as determined by ASTM C-136 or F1632.

Sieve	Sieve Size	% Passing
No. 4	4.75 mm	100%
No. 8	2.38 mm	90 - 100%
No. 16	1.19 mm	80 - 100%
No. 30	0.60 mm	25 - 60
No. 50	0.30 mm	0 - 25%
No. 100	0.15 mm	0 - 5
No. 270	0.075 mm	0 - 3

In addition, the sand shall have a coefficient of uniformity (D60/D10) of less than 4.0.

F. Commercial fertilizer shall be a product complying with the State and United States fertilizer laws. Deliver fertilizer to the site in the original unopened containers bearing the manufacturer's certificate of compliance covering analysis and which shall be furnished to the Architect. Fertilizer shall contain not less than the percentages of weight of ingredients as recommended by the soil analysis.

1. Fertilizer for planting shall be formulated for top-dressing, soil surface application to plants. Fertilizer shall be designed and certified by the manufacturer to provide controlled release of fertilizer continuously for not less than 9 months. One hundred percent of the nitrogen content shall be derived from organic materials. Nitrogen source shall be coated to ensure slow release. Fertilizer percentages of weight of ingredients shall be as recommended by the soil testing and analysis specified, performed, and paid for under this Section, "Planting Soils."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: in the event field conditions are not as shown on Drawings and outlined in the specifications, notify Owner's Representative in writing.

1. Spot and Invert Elevations: verify field elevations of site improvements such as drainage and utility fixtures, pavements, existing plantings, and subsurface piping conform to Drawings.
2. Rough grade: verify specified elevations and prior earthwork operations have shaped, trimmed, and finished rough grade.

3.2 PREPARATION

A. Protection:

1. Contractor shall be required to clear working areas with Ohio Utility Protection Service prior to doing excavation on site. If work is to be done around underground utilities, appropriate authority of utility must be notified of impending work. Hand excavate areas adjacent to utilities. Contractor shall be responsible for damages done by himself or his personnel to existing utilities, which shall be repaired or paid for by Contractor.

3.3 MIXING PLANTING SOIL

A. Soil additives shall be thoroughly incorporated into planting soil by harrowing or other methods standard to the industry.

B. Correct deficiencies in soil as directed by horticultural soil test results. Thoroughly incorporate amendments into planting mixture to ensure even distribution.

3.4 FILLING AND COMPACTION

A. Perform percolation tests on existing sub-soils or placed fill prior to placing and spreading planting soils (this requirement is waived where there is under drain perforated piping):

1. Perform percolation testing of subsoil or placed fills to determine whether or not the subgrade will drain properly. Perform percolation tests as specified in this Section - for each lift of loam borrow.
2. In the event that percolation testing indicates that the subsoil, placed fills or ordinary borrow has been over compacted and will not drain, the contractor shall loosen up the top 12 inches of the subgrade to be planted and seeded by ripping or other mechanical means. Re-compact the borrow by driving a small, tracked bulldozer over the area at low speeds so that the tracks of the bulldozer pass over the affected area and the soil is compacted to a density that will percolate. Under no circumstances shall wheeled vehicles be driven over subsoil, placed fills or ordinary borrow that have been shown to percolate or subsoil, placed fills or ordinary borrow that has been loosened and shown to percolate.
3. Perform sufficient percolation tests in areas of poorly draining or compacted subsoil or compacted placed fills as directed by the Architect to ensure that these underlying soils

drain. Likewise, perform sufficient percolation tests after ripping and loosening to ensure that the soils are no longer too compact to drain.

B. Do not damage the work previously installed. Maintain all required angles of repose of materials adjacent to the loam as shown on the Drawings. Do not over excavate compacted subgrades of adjacent pavement or structures during loaming operations.

C. Confirm that the subgrade is at the proper elevation and that no further earthwork is required to bring the subgrade to proper elevations. Subgrade elevations shall slope parallel to the finished grade and or toward the subsurface drain lines as shown on the Drawings.

D. Clear the subgrade of all construction debris, trash, rubble and any foreign material. In the event that fuels, oils, concrete washout or other material harmful to plants have been spilled into the subgrade material, excavate the soil sufficiently to remove the harmful material. Such construction debris, trash, rubble and foreign material shall be removed from the site and disposed of in a legal manner. Fill any over excavation with approved fill and compact to the required subgrade compaction levels.

E. Do not proceed with the installation of amended topsoil until all utility work in the area has been installed.

F. Protect adjacent walls, walks and utilities from damage or staining by the soils. Use 0.5-inch plywood and or plastic sheeting as directed to cover existing concrete, metal and masonry work and other items as directed during the progress of the work. Clean up all trash and any soil or dirt spilled on any paved surface at the end of each working day.

3.5 SOIL VOLUMES

A. Plant soil volumes required for trees are as follows:

1. Large canopy trees and evergreens:
   a. Single trees: 500 cubic feet per tree
   b. Trees in groups of two (2) or more: 350 cubic feet per tree

2. Flowering and ornamental trees:
   a. Single trees: 300 cubic feet per tree
   b. Trees in groups of two (2) or more: 200 cubic feet per tree

B. Planting soil depth for plant beds containing shrubs, perennials, ornamental grasses and groundcover shall be 12 inches.

C. Planting soil depth for turf areas shall be 6 inches.

3.6 FINE GRADING

A. Immediately prior to dumping and spreading loam borrow, the subgrade shall be cleaned of all stones greater than 2 inches in any dimension and all debris or rubbish. Such material shall be removed from the site, not raked to the edges and buried. Notify the Architect that the subsoil has been cleaned and request his/her attendance on site to review and approve subgrade conditions prior to spreading loam borrow.

B. Notify the Architect when the amended topsoil is scheduled for placement and schedule his/her attendance on site to witness delivery and stockpiling. Architect will inspect the amended topsoil for conformance to the requirements of this Section.

C. Amended topsoil shall be protected from erosion at all times. Materials shall be spread immediately upon approval soil test reports. Otherwise, materials that set on site for more than 24 hours shall be covered with tarpaulin or other soil erosion system acceptable to the Architect and surrounded by silt fence.

D. Place amended topsoil in two lifts. Place the first lift to a depth of 2 inches and harrow or till the loam into the underlying subsoil to a depth of 2 inches, creating a blended interface of loam and subsoil approximately 4 inches deep. Spread the second lift of loam to a minimum depth of 4 inches or greater as shown on the Drawings.

E. No loam borrow shall be handled, planted, or seeded in any way if it is in a wet or frozen condition. A moist loam borrow is desirable.

F. Fertilizer shall be spread and thoroughly incorporated into the top layer of the amended topsoil by harrowing or other method reviewed by the Architect. Fertilizer shall be applied at the rate recommend by the soil analysis.

G. Remove all large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter. Remove from unscreened soils all stones over 1 inch in ay dimension from the top 6 inches of the amended topsoil bed. Amended topsoil shall also be free of smaller stones in excessive quantities as determined by the Architect.

H. The Contractor shall install amended topsoil in successive horizontal lifts no thicker than 6 inches in turf areas and 12 inches in plant bed areas to the desired compaction as described herein. The Contractor shall install the soil at a higher level to anticipate any reduction of amended topsoil volume due to compaction, settling, erosion, decomposition, and other similar processes during the warranty period. The Architect will ensure that the full depths of amended topsoil for turf and plant beds are obtained by digging holes in the amended topsoil at the same frequency as for compaction testing.

1. Compact planting soil to the required density as specified herein.
2. Maximum dry density planting soil shall be determined in accordance with ASTM D698. The following percentages of minimum to maximum dry densities shall be achieved for amended topsoil.

   In turf, plant beds and tree pits:

	Minimum	Maximum
a. Fills within turf and planting areas in top eighteen inches of finished grade	83%	86%

3. The surface area of each lift shall be scarified by raking prior to placing the next lift.

I. Compaction:

1. For amended topsoil for general use in turf and plant beds, compact each lift sufficiently to reduce settling but not enough to prevent the movement of water and feeder roots through the soil. The amended topsoil in each lift should feel firm to the foot in all areas and make only slight heel prints. At completion of the loam borrow installation, the soil should offer a firm, even resistance when a soil sampling tube is inserted from lift to lift.

J. Percolation test procedure:

1. Dig a hole in the installed soil that is a minimum of 4 inches in diameter. Holes in 6-inch lift in turf areas shall be 4 inches deep. Holes in 12-inch lifts in plant beds shall be 8 inches deep. Do not penetrate through the lift being tested.
2. Fill the hole with water and let it drain completely. Immediately refill the hole with water and measure the rate of fall in the water level.
3. In the event that the water drains at a rate less than one inch per hour, till the soil to a depth required to break the over compaction.
4. Perform a minimum of one soil percolation test per 10,000 square feet area of turf area and 2,500 square feet of tree and shrub planting area as directed by the Architect.
5. Do not spread any amended topsoil for general use until placed materials have been tested for percolation rates.

K. Select equipment and otherwise phase the installation of the amended topsoil to ensure that wheeled equipment does not travel over subsoil, placed fills or ordinary borrow or already installed soil. Movement of tracked equipment over said soils will be reviewed and considered for approval by the Architect. If it is determined by the Architect that wheeled equipment must travel over already installed soil, provide a written description of sequencing of work that ensures that compacted soil is loosened and un-compacted as the work progresses or place one-inch thick steel plate ballast (or equivalent ballast approved by the Architect) over the length and width of any travel way to cover loam borrow to protect it from compaction.

L. Disturbed areas outside the limit of turf work shall be graded smooth and spread with a minimum of 6 inches of loam borrow to the finished grade.

3.7 CLEANING

A. Clean up debris generated under work of this section.

B. Site Improvements

1. Wash and sweep clean site improvements such as drainage and utility fixtures, pavements, existing plantings, and site furnishings.

3.8 PROTECTION

A. Protect work of this section until Final Acceptance.

B. Protect prepared soils from compaction by construction traffic and from contamination by construction materials and from saturation.

3.9 ACCEPTANCE

A. Confirm that the final grade of the loam borrow is at the proper finish grade elevations. Adjust grade as required to meet the contours and spot elevations noted on the Drawings. Request the presence of the Architect to inspect final grade. Do not proceed with the remaining work of this Contract until the Architect has given his/her written approval of the final grade.

END OF SECTION 329113

SECTION 329200 - TURF AND GRASSES

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. Seeding.
2. Turf renovation.
3. Erosion-control material(s).

B. Related Requirements:

1. Section 329113 “Planting Soils” for planting soil mix and installation.
2. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Planting Soil.”

E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

C. Product Certificates: For fertilizers, from manufacturer.

D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
2. Experience: Three years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in all of the following categories from the Professional Landcare Network:

    a. Landscape Industry Certified Technician - Exterior.
    b. Landscape Industry Certified Lawncare Manager.
    c. Landscape Industry Certified Lawncare Technician.

5. Pesticide Applicator: State licensed, commercial.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.9 FIELD CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion.

1. Spring Planting: March 15 to June 1.
2. Fall Planting: August 15 to November 1.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Mix: Seed of grass species as follows, with not less than 95 percent germination, not less than 100 percent pure seed, and completely free of noxious weeds and grasses. The mixture shall be as follows or an approved equal: (Mixture shall rate in NTEP's top ten. Contractor to provide information on grass seed stating it meets NTEP's top ten list)
1. 80 percent Turf-type Tall Fescue consisting of minimum 3 varieties.
2. 10 percent Perennial Ryegrass.
3. 10 percent Kentucky Bluegrass.

2.2 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.3 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

2.4 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.5 EROSION-CONTROL MATERIALS

A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long.

B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd., with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches long.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

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

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Planting Soils."

B. Placing Planting Soil: Place planting soil according to Section 329113 “Planting Soils.”

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

A. Prepare area as specified in "Turf Area Preparation" Article.

B. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.

C. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.5 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.

1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
2. Do not use wet seed or seed that is moldy or otherwise damaged.
3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate of 6 to 8 lb/1000 sq. ft.

C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets and 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.

E. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.

3.6 TURF RENOVATION

A. Renovate existing turf where indicated.

B. Renovate turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
2. Install new planting soil as required.

C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.

D. Remove topsoil containing foreign materials, such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.

E. Mow, dethatch, core aerate, and rake existing turf.

F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.

I. Apply initial fertilizer required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.

1. Initial Fertilizer: Commercial fertilizer applied according to manufacturer's recommendations.

J. Apply seed and protect with straw mulch as required for new turf.

K. Water newly planted areas and keep moist until new turf is established.

3.7 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.

2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow turf to a height of 2 to 3 inches.

D. Turf Postfertilization: Apply commercial fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.8 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

PESTICIDE APPLICATION

C. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

D. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.9 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

3.10 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

1. Seeded Turf: 60 days from date of planting completion.

a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

END OF SECTION 329200

SECTION 329300 - PLANTS

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. Plants.

B. Related Requirements:

1. Section 329113 “Planting Soils” for plant soil mix and installation.
2. Section 329200 "Turf and Grasses" for turf (lawn) and erosion-control materials.

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

D. Finish Grade: Elevation of finished surface of planting soil.

E. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.

F. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

G. Planting Area: Areas to be planted.

H. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Planting Soils."

I. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

J. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

K. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

L. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 COORDINATION

A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
2. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Samples for Verification: For each of the following:

1. Organic Mulch: 1-pint volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Manufacturer's certified analysis of standard products.
2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

D. Sample Warranty: For special warranty.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
2. Experience: Three years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in all of the following categories from the Professional Landcare Network:

a. Landscape Industry Certified Technician - Exterior.
b. Landscape Industry Certified Horticultural Technician.

5. Pesticide Applicator: State licensed, commercial.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.

2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Architect of sources of planting materials seven days in advance of delivery to site.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

D. Handle planting stock by root ball.

E. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

F. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
2. Do not remove container-grown stock from containers before time of planting.
3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.11 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: March 15 to June 1.
2. Fall Planting: August 15 to November 1.

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.12 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
b. Structural failures including plantings falling or blowing over.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Periods: From date of planting completion.

a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.

3. Include the following remedial actions as a minimum:

a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by

transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.

E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

2.2 FERTILIZERS

A. Add fertilizer to planting soil mix according to Section 329113 “Planting Soils.”

2.3 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Shredded hardwood.
2. Size Range: 3 inches maximum, 1/2 inch minimum.
3. Color: Natural.

2.4 PESTICIDES

A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.5 MISCELLANEOUS PRODUCTS

A. Burlap: Non-synthetic, biodegradable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

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

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Planting Soils."

B. Placing Planting Soil: Install planting soil according to Section 329113 “Planting Soils.”

C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.

1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
2. Excavate approximately three times as wide as ball diameter for balled and burlapped and container-grown stock.
3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
5. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
6. Maintain supervision of excavations during working hours.
7. Keep excavations covered or otherwise protected when unattended by Installer's personnel.

B. Backfill Soil: Subsoil and topsoil removed from excavations may not be used as backfill soil unless otherwise indicated.

C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

1. Hardpan Layer: Drill 6-inch-diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

3.5 TREE, SHRUB, AND VINE PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Balled and Burlapped and Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.

1. Backfill: Planting soil according to Section 329113 “Planting Soils.”
2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 TREE, SHRUB, AND VINE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Do not apply pruning paint to wounds.

3.7 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Organic Mulch in Planting Areas: Apply 2-inch average thickness of organic mulch extending 12 inches beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.8 EDGING INSTALLATION

A. Shovel-Cut Edging: Separate mulched areas from turf areas, curbs, and paving with a 45-degree, 4- to 6-inch-deep, shovel-cut edge.

3.9 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.10 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.11 REPAIR AND REPLACEMENT

A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Remove and replace plants that are more than 25 percent dead or in an unhealthy condition or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

1. Provide new plants of same size and species as those being replaced

3.12 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

D. After installation and before project completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.13 MAINTENANCE SERVICE

A. Maintenance Service for Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: 12 months from date of planting completion.

END OF SECTION 329300

SECTION 331100 - WATER DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This section includes water-distribution piping and related components outside of the building for domestic, fire, and combined water service mains.

1.3 DEFINITIONS

A. PE: Polyethylene plastic.

B. PP: Polypropylene plastic.

C. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. All work must be done in compliance with the local water jurisdiction having authority, the local building department, the governing fire department, and all applicable state and national codes. If local codes conflict with project specifications or project plans the contractor should contact the Construction Manager.

B. Minimum working pressures: The following are minimum pressure requirements for piping and specialties:
   1. Domestic Water Service: 200 psi
   2. Fire Protection Water Service: 250 psi

C. Regulatory Requirements:

   1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
   2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

D. Piping materials shall bear label, stamp, or other markings of specified testing agency.

E. 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.

F. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

G. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

H. NSF Compliance:
1. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping 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.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution 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 water-distribution service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without Owner's permission.

1.8 COORDINATION

A. Coordinate connection to water main with University.

B. Coordinate water main installation with other utility work.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: Class 52 minimum, 250 psi minimum pressure rating, AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated. The interior of the pipe shall be cement-mortar lined and seal coated in accordance with AWWA C104. The exterior of all pipe shall receive wither coal tar or asphalt base coating a minimum of 1 mil thick.

1. Mechanical-Joint, Ductile-Iron Fittings: 250 psi minimum pressure rating, AWWA C110, ductile-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile-iron glands, rubber gaskets, and Core 10 Alloy Steel only bolts.

B. Push-on-Joint, Ductile-Iron Pipe: Class 52 minimum, 250 psi minimum pressure rating, AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated. The interior of the pipe shall be cement-mortar lined and seal coated in accordance with AWWA C104. The exterior of all pipe shall receive wither coal tar or asphalt base coating a minimum of 1 mil thick.

1. Push-on-Joint, Ductile-Iron Fittings: 250 psi minimum pressure rating, AWWA C110, ductile-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

2.2 GATE VALVES

A. AWWA, Gate Valves:

1. Nonrising-Stem, High-Pressure, Resilient-Seated Gate Valves:

a. Description: Ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut.

1) Standard: AWWA C509.
2) Minimum Pressure Rating: 250 psig.
3) End Connections: Push on or mechanical joint.
4) Interior Coating: Complying with AWWA C550.

2.3 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER,"

and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

PART 3 - EXECUTION

3.1 EARTHWORK

A. General:
   1. Conduit Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type B Conduits.
   2. Conduit Not Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type C Conduits.

B. Excavation For Utility Trenches:
   1. Excavate trenches to indicated slopes, lines, depths, and invert elevations.
   2. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit.
   3. Excavate trench walls per ODOT Item 603.05 and geotechnical report as identified on the Drawings.
   4. Where encountering rock or another unyielding bearing surface, carry trench excavation 6 inches below invert elevation to receive bedding course.

C. Utility Trench Backfill:
   1. Place and compact bedding course as required by ODOT specifications Item 603.06 and geotechnical report. Type 2 bedding consists of structural backfill extending at least 3 inches (75 mm) for all ODOT Item 706 rigid pipe conduits and 6 inches (150 mm) for all other conduits below the bottom of the conduit for the full width of the trench. Extend the bedding up around the pipe for a depth of not less than 30 percent of the rise of the conduit. Shape the bedding to fit the conduit with recesses shaped to receive the bell of bell-and-spigot pipe. Leave the bedding below the middle one-third of the pipe span uncompacted. Compact the remaining bedding according to ODOT Item 603.11.
   2. Use Type 2 bedding for Types A, B, C, and D conduits except for long span structures and for conduits that require Type 3 bedding.
   3. Type 3 bedding consists of a natural foundation with recesses shaped to receive the bell of bell-and-spigot pipe. Scarify and loosen the middle one-third of the pipe span.
   4. Use Type 3 bedding for Type C and Type D conduits of the following materials: ODOT Items 706.01, 706.02, or 706.03.
   5. Structural backfill for ODOT Item 603 bedding and backfill shall consist of limestone, gravel, natural sand, sand manufactured from stone, or foundry sand. Provide Type I or Type II structural backfill per the requirements of ODOT Item 703.11
   6. Non-structural backfill should consist of clean, inorganic soil free of any miscellaneous materials, cobbles, and boulders. The fill should be placed in uniform, thin lifts and carefully compacted to a unit dry weight equal to 100 percent in structure areas and at least 98 percent of the maximum dry weight below pavement areas. The moisture content of the fill should be maintained at –2 to +1 percent of the optimum moisture content as determined in the laboratory by the Standard Test Methods for Moisture-Density Relations of Soils (ASTM D 698). Fill should not be placed in a frozen condition or upon a frozen subgrade.

7. Place backfill to the limits described and according to the compaction requirements of ODOT Item 603.11. Place the backfill in the trench and embankment outside the trench uniformly on both sides of the conduit for all conduit installations.
    a. Type A and B. Backfill Types A and B conduits except for long span structures as follows
        1) In a cut situation, place and compact structural backfill above the bedding for the full depth of the trench. Within the trench and more than 4 feet (1.2 m) above the top of the conduit, if the trench can accommodate compaction equipment, the Contractor may construct Item 203 Embankment. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
        2) In a fill situation, place and compact structural backfill above the bedding for the full depth of the trench specified in 603.05.B. Above these limits, uniformly place the lesser of one pipe span or 4 feet (1.2 m) of structural backfill on each side of the conduit and to a depth of 2 feet (0.6 m) above the top of the conduit. Construct the embankment outside the limits of the backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
    b. Type C and D. Backfill Type C and D conduits as follows:
        1) In a cut situation, for plastic pipe, place and compact structural backfill above the bedding and to 12 inches (300 mm) over the top of the pipe. All other conduit material types place and compact backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
        2) In a fill situation, for plastic pipe, place and compact structural backfill above the bedding for the full depth of the trench specified in 603.05.B. Above these limits, uniformly place the lesser of one pipe span or 4 feet (1.2 m) of structural backfill on each side of the conduit and vertically to the top of the conduit. Then place for a depth of 12 inches (300 mm) structural backfill over the top of the pipe equal to the trench width centered on the pipe center line. Construct the embankment outside the limits of the backfill. All other conduit material types place and compact backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
8. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
9. All fill soils shall be placed in accordance with the article “Compaction of Soil Backfills and Fills” from the Earth Moving Specification Section 312000.
10. Coordinate backfilling with utilities testing.
11. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.
12. Place and compact final backfill of satisfactory soil material to final subgrade.

3.2 PIPING INSTALLATION

A. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
    1. Make connections larger than NPS 2 with tapping machine in accordance with the jurisdiction having authority.
    2. Make connections NPS 2 and smaller with drilling machine in accordance with the jurisdiction having authority.

B. Comply with NFPA 24 for fire-service-main piping installation.

C. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

D. Bury piping with depth of cover over top at least 48 inches below finish grade.

E. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

F. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

G. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.3 ANCHORAGE INSTALLATION

A. Anchorage, General: Only the following may be used for anchorages and restrained-joint types:

1. Concrete thrust blocks.
2. Locking mechanical joints.
3. Set-screw mechanical retainer glands.
4. Bolted flanged joints.
5. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.4 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

3.5 FIRE HYDRANT INSTALLATION

A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints and thrust blocks, and support in upright position.

B. AWWA Fire Hydrants: Comply with AWWA M17.

3.6 CONNECTIONS

A. Connect water-distribution piping to existing water main. Use tapping sleeve and tapping valve, or service clamp and corporation valve.

B. Connect water-distribution piping to interior domestic water and fire-suppression piping if in place. Coordinate connection with plumber.

C. Connect drainage piping from concrete vault drains to storm-drainage system swale or pipe.

3.7 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

2. All pipe, fittings and other materials found to be defective under test shall be removed and replaced at the contractors expense.

C. Prepare reports of testing activities.

3.8 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
b. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
c. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 331100

SECTION 333100 – SANITARY SEWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes gravity-flow, nonpressure sanitary sewerage outside the building, with the following components:

1. Cleanouts.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. PP: Polypropylene plastic.

C. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Piping Pressure Rating: at least equal to system test pressure.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Pipe.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store pipe and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Sewerage 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 two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Owner's permission.

PART 2 - PRODUCTS

2.1 ABS PIPE AND FITTINGS

A. ABS Sewer Pipe and Fittings: ASTM D 2751, with bell-and-spigot ends for gasketed joints.

1. NPS 3 to NPS 6: SDR 35.
2. Gaskets: ASTM F 477, elastomeric seals.

2.2 PVC PIPE AND FITTINGS

A. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with integral bell-and-spigot rubber gasketed joints per ASTM D 3212.

PART 3 - EXECUTION

3.1 EARTHWORK

A. General:
1. Conduit Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type B Conduits.
2. Conduit Not Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type C Conduits.

B. Excavation For Utility Trenches:
1. Excavate trenches to indicated slopes, lines, depths, and invert elevations.
2. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit.
3. Excavate trench walls per ODOT Item 603.05 and geotechnical report as identified on the Drawings.
4. Where encountering rock or another unyielding bearing surface, carry trench excavation 6 inches below invert elevation to receive bedding course.

C. Utility Trench Backfill:
1. Place and compact bedding course as required by ODOT specifications Item 603.06 and geotechnical report. Type 2 bedding consists of structural backfill extending at least 3 inches (75 mm) for all ODOT Item 706 rigid pipe conduits and 6 inches (150 mm) for all other conduits below the bottom of the conduit for the full width of the trench. Extend the bedding up around the pipe for a depth of not less than 30 percent of the rise of the conduit. Shape the bedding to fit the conduit with recesses shaped to receive the bell of bell-and-spigot pipe. Leave the bedding below the middle one-third of the pipe span uncompacted. Compact the remaining bedding according to ODOT Item 603.11.
2. Use Type 2 bedding for Types A, B, C, and D conduits except for long span structures and for conduits that require Type 3 bedding.

3. Type 3 bedding consists of a natural foundation with recesses shaped to receive the bell of bell-and-spigot pipe. Scarify and loosen the middle one-third of the pipe span.
4. Use Type 3 bedding for Type C and Type D conduits of the following materials: ODOT Items 706.01, 706.02, or 706.03.
5. Structural backfill for ODOT Item 603 bedding and backfill shall consist of limestone, gravel, natural sand, sand manufactured from stone, or foundry sand. Provide Type I or Type II structural backfill per the requirements of ODOT Item 703.11
6. Non-structural backfill should consist of clean, inorganic soil free of any miscellaneous materials, cobbles, and boulders. The fill should be placed in uniform, thin lifts and carefully compacted to a unit dry weight equal to 100 percent in structure areas and at least 98 percent of the maximum dry weight below pavement areas. The moisture content of the fill should be maintained at –2 to +1 percent of the optimum moisture content as determined in the laboratory by the Standard Test Methods for Moisture-Density Relations of Soils (ASTM D 698). Fill should not be placed in a frozen condition or upon a frozen subgrade.
7. Place backfill to the limits described and according to the compaction requirements of ODOT Item 603.11. Place the backfill in the trench and embankment outside the trench uniformly on both sides of the conduit for all conduit installations.
    a. Type A and B. Backfill Types A and B conduits except for long span structures as follows
        1) In a cut situation, place and compact structural backfill above the bedding for the full depth of the trench. Within the trench and more than 4 feet (1.2 m) above the top of the conduit, if the trench can accommodate compaction equipment, the Contractor may construct Item 203 Embankment. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
        2) In a fill situation, place and compact structural backfill above the bedding for the full depth of the trench specified in 603.05.B. Above these limits, uniformly place the lesser of one pipe span or 4 feet (1.2 m) of structural backfill on each side of the conduit and to a depth of 2 feet (0.6 m) above the top of the conduit. Construct the embankment outside the limits of the backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
    b. Type C and D. Backfill Type C and D conduits as follows:
        1) In a cut situation, for plastic pipe, place and compact structural backfill above the bedding and to 12 inches (300 mm) over the top of the pipe. All other conduit material types place and compact backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
        2) In a fill situation, for plastic pipe, place and compact structural backfill above the bedding for the full depth of the trench specified in 603.05.B. Above these limits, uniformly place the lesser of one pipe span or 4 feet (1.2 m) of structural backfill on each side of the conduit and vertically to the top of the conduit. Then place for a depth of 12 inches (300 mm) structural backfill over the top of the pipe equal to the trench width centered on the pipe center line. Construct the embankment outside the limits of the backfill. All other conduit material types place and compact backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
8. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
9. All fill soils shall be placed in accordance with the article “Compaction of Soil Backfills and Fills” from the Earth Moving Specification Section 312000.
10. Coordinate backfilling with utilities testing.

11. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.
12. Place and compact final backfill of satisfactory soil material to final subgrade.

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, contact Construction Manager.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

D. Install gravity-flow, nonpressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 2 percent, unless otherwise indicated.
2. Install piping with 36-inch minimum cover unless otherwise indicated.
3. Install ABS sewer piping according to ASTM D 2321 except as modified by this section or as required by the jurisdiction having authority.
4. Install PVC sewer piping according to ASTM D 2321 except as modified by this section or as required by the jurisdiction having authority.

E. Clear interior of piping of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

A. Preparatory to making pipe joints, all joint surfaces shall be cleaned of all dirt, dust, and foreign matter and shall be dry, smooth, and free of imperfections before placing joining materials. Gaskets, lubricants, primers, adhesives, or other joining, materials shall be used as recommended by the pipe or joint manufacturer’s specifications. Generally, lubricants and primers and adhesives shall be places on both the bell and spigot portions of the joint. The pipe shall then be placed, fitted, joined, and adjusted in such a workmanlike manner as to obtain the degree of watertightness required. In the event that pipe previously laid is disturbed due to any cause, it shall be removed and relaid.

B. Joints that show leakage will not be accepted. If after backfilling and inspection, any joints are found to be allowing groundwater to enter the sewer, such joints shall be sealed by the contractor at no cost to the owner.

C. No fittings (except service wyes and repair couplings) shall be allowed in gravity sewers. Open ends of wyes shall be plugged or sealed until service laterals are installed.

D. Join gravity-flow, nonpressure, drainage piping according to the following:

1. Join ABS sewer piping according to ASTM D 2321 except as modified by this section or as required by the jurisdiction having authority.
2. Join PVC sewer piping according to ASTM D 2321 except as modified by this section or as required by the jurisdiction having authority.
3. Join dissimilar pipe materials with nonpressure-type, flexible couplings.

3.4 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Division 22 Section "Sanitary Waste and Vent Piping."

B. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

    a. Use concrete that will attain minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.
    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

C. Connect to grease interceptors specified in Division 22 Section "Sanitary Waste Interceptors."

3.5 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate report for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.

e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice. If authorities having jurisdiction do not have published procedures, or if sewer does not fall under a jurisdiction, perform tests as follows:
4. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

a. Allowable leakage is maximum of 50 gal./inch of nominal pipe size per mile of pipe, during 24-hour period.
b. Close openings in system and fill with water.
c. Purge air and refill with water.
d. Disconnect water supply.
e. Test and inspect joints for leaks.

5. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

a. Option: Test plastic gravity sewer piping according to ASTM F 1417.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.6 CLEANING

A. Clean interior of piping of dirt and superfluous material.

END OF SECTION 333100

SECTION 334100 - STORM DRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes gravity-flow, nonpressure storm drainage outside the building, with the following components:
   1. Cleanouts.

1.3 DEFINITIONS

A. PE: Polyethylene plastic.

B. PVC: Polyvinyl chloride plastic.

C. ODOT: Ohio Department of Transportation

1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water. Pipe joints shall be at least silttight, unless otherwise indicated.

1.5 SUBMITTALS

A. Product Data: For the following:

   1. Pipe.
   2. Cleanouts.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store pipe and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage 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 two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Owners's permission.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Conduit Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type B Conduits.

B. Conduit Not Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type C Conduits.

2.2 PE PIPE AND FITTINGS

A. Per the latest version of the ODOT Construction and Material Specifications and as noted on the Drawings.

2.3 PVC PIPE AND FITTINGS

A. Per the latest version of the ODOT Construction and Material Specifications and as noted on the Drawings.

B. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

C. PVC Profile Gravity Sewer Pipe and Fittings: ASTM F 794 pipe, with bell-and-spigot ends; ASTM D 3034 fittings, with bell ends; and ASTM F 477, elastomeric seals.

2.4 CLEANOUTS

A. PVC with cast iron adaptor: Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping. Include cast iron adaptor and threaded brass closure plug.

PART 3 - EXECUTION

3.1 EARTHWORK

A. General:
1. Conduit Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type B Conduits.

2. Conduit Not Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type C Conduits.

B. Excavation For Utility Trenches:
1. Excavate trenches to indicated slopes, lines, depths, and invert elevations.
2. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit.
3. Excavate trench walls per ODOT Item 603.05 and geotechnical report as identified on the Drawings.
4. Where encountering rock or another unyielding bearing surface, carry trench excavation 6 inches below invert elevation to receive bedding course.

C. Utility Trench Backfill:
1. Place and compact bedding course as required by ODOT specifications Item 603.06 and geotechnical report. Type 2 bedding consists of structural backfill extending at least 3 inches (75 mm) for all ODOT Item 706 rigid pipe conduits and 6 inches (150 mm) for all other conduits below the bottom of the conduit for the full width of the trench. Extend the bedding up around the pipe for a depth of not less than 30 percent of the rise of the conduit. Shape the bedding to fit the conduit with recesses shaped to receive the bell of bell-and-spigot pipe. Leave the bedding below the middle one-third of the pipe span uncompacted. Compact the remaining bedding according to ODOT Item 603.11.
2. Use Type 2 bedding for Types A, B, C, and D conduits except for long span structures and for conduits that require Type 3 bedding.
3. Type 3 bedding consists of a natural foundation with recesses shaped to receive the bell of bell-and-spigot pipe. Scarify and loosen the middle one-third of the pipe span.
4. Use Type 3 bedding for Type C and Type D conduits of the following materials: ODOT Items 706.01, 706.02, or 706.03.
5. Structural backfill for ODOT Item 603 bedding and backfill shall consist of limestone, gravel, natural sand, sand manufactured from stone, or foundry sand. Provide Type I or Type II structural backfill per the requirements of ODOT Item 703.11
6. Non-structural backfill should consist of clean, inorganic soil free of any miscellaneous materials, cobbles, and boulders. The fill should be placed in uniform, thin lifts and carefully compacted to a unit dry weight equal to 100 percent in structure areas and at least 98 percent of the maximum dry weight below pavement areas. The moisture content of the fill should be maintained at –2 to +1 percent of the optimum moisture content as determined in the laboratory by the Standard Test Methods for Moisture-Density Relations of Soils (ASTM D 698). Fill should not be placed in a frozen condition or upon a frozen subgrade.
7. Place backfill to the limits described and according to the compaction requirements of ODOT Item 603.11. Place the backfill in the trench and embankment outside the trench uniformly on both sides of the conduit for all conduit installations.
    a. Type A and B. Backfill Types A and B conduits except for long span structures as follows
        1) In a cut situation, place and compact structural backfill above the bedding for the full depth of the trench. Within the trench and more than 4 feet (1.2 m) above the top of the conduit, if the trench can accommodate compaction equipment, the Contractor may construct Item 203 Embankment. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
        2) In a fill situation, place and compact structural backfill above the bedding for the full depth of the trench specified in 603.05.B. Above these limits, uniformly place the lesser of one pipe span or 4 feet (1.2 m) of structural backfill on each side of the conduit and to a depth of 2 feet (0.6 m) above the top of the conduit. Construct the embankment outside the limits of the

backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.

b. Type C and D. Backfill Type C and D conduits as follows:

1) In a cut situation, for plastic pipe, place and compact structural backfill above the bedding and to 12 inches (300 mm) over the top of the pipe. All other conduit material types place and compact backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.

2) In a fill situation, for plastic pipe, place and compact structural backfill above the bedding for the full depth of the trench specified in 603.05.B. Above these limits, uniformly place the lesser of one pipe span or 4 feet (1.2 m) of structural backfill on each side of the conduit and vertically to the top of the conduit. Then place for a depth of 12 inches (300 mm) structural backfill over the top of the pipe equal to the trench width centered on the pipe center line. Construct the embankment outside the limits of the backfill. All other conduit material types place and compact backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.

8. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
9. All fill soils shall be placed in accordance with the article “Compaction of Soil Backfills and Fills” from the Earth Moving Specification Section 312000.
10. Coordinate backfilling with utilities testing.
11. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.
12. Place and compact final backfill of satisfactory soil material to final subgrade.

3.2 PIPING INSTALLATION

A. All installation shall be per the latest version of the ODOT Construction and Material Specifications item 603 and the latest version of the ODOT Standard Construction Drawings.

B. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, contact architect.

C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

D. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

E. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

F. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.

2. Install piping with 12inches minimum cover, unless otherwise indicated on the drawings. Notify architect if less than 12 inches of cover will exist.
3. During construction protect installed piping from damage. Maintain manufacturers recommended minimum cover.

3.3 PIPE JOINT CONSTRUCTION

A. All joint construction shall be per the latest version of the ODOT Construction and Material Specifications item 603 and the latest version of the ODOT Standard Construction Drawings.

B. Join dissimilar pipe materials with pressure-type couplings, or concrete collar.

3.4 CLEANOUT INSTALLATION

A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
1. Use medium-duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
2. Use heavy-duty, top-loading classification cleanouts in paved foot-traffic, vehicle-traffic, roads, and service areas.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding earth grade.

C. Set cleanout frames and covers in asphalt or concrete pavement with tops flush with pavement surface.

3.5 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section "Facility Storm Drainage Piping."

3.6 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
1. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Crushed, broken, cracked, or otherwise damaged piping.

2. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
3. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.

C. Replace defective piping using new materials, and repeat testing until defect is within allowances specified.

3.7 CLEANING

A. Clean interior of piping of dirt and superfluous materials.

END OF SECTION 334100