SPECIFICATIONS
FOR THE
PUBLIC WORKS BUILDING

Prepared for
City of Margate City
Atlantic County, New Jersey
July 2026

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REMINGTON & VERNICK ENGINEERS
2819 Fire Road, 1st Floor
Egg Harbor Township, NJ 08234
(609) 645-7110

RVE Project No. 0116U200

Set No. ——

NOTICE TO BIDDERS

PUBLIC NOTICE IS HEREBY GIVEN that sealed bids will be received by the City of Margate City for the New Public Works Building in the City of Margate City, Atlantic County, New Jersey.

Bid forms, contracts and specifications are on file at the office of Remington & Vernick Engineers, 2819 Fire Road, 1st Floor, Egg Harbor Township, NJ 08234

A non-mandatory pre-bid meeting will be held on July 23, 2026 at 10:00 AM in the Margate Municipal Building, 9001 Winchester Avenue, Margate, New Jersey 08402.

Said Bids will be received, opened and read aloud in public at the Margate Municipal Building, 9001 Winchester Avenue, Margate, New Jersey, Atlantic County, New Jersey on August 13, 2026 at 11:00 A.M. prevailing time.

Electronic copies of the bid forms, contracts and specifications may be obtained from said Remington and Vernick Engineers (609-645-7110) or EHTOffice@rve.com, by prospective bidders upon request, upon payment of the sum of $50.00 for each set. Hard copies of the bid forms, contracts and specifications are available upon request.

All work in the project is subject to the Project Labor Agreement (PLA) contained in the specifications and that all contractors and subcontractors will be required to provide the Schedule C "Contractors Letters of Assent" of the PLA as a condition of any contract award.

PAYMENT MUST BE RECEIVED PRIOR TO OBTAINING SAID SPECIFICATIONS, EITHER BY MAIL OR IN PERSON.

NO BIDS ARE TO BE DROPPED OFF AT THE ENGINEER'S OFFICE.

The City of Margate City reserves the right to consider the bids for sixty (60) days after the receipt thereof, and further reserves the right to reject any or all bids, either in whole or in part and also to waive any informality in any and make such awards or take action as may be in the best interest of the City of Margate City, in accordance with applicable law.

Bids must be on the bid form prepared by Remington & Vernick Engineers, in the manner designated therein and required by the specifications, must be enclosed in sealed envelopes bearing the name and address of the bidder on the outside and also bearing on the outside reference to the particular work bid upon. Said bids shall be addressed to Johanna Casey, R.M.C., Margate City Clerk., City of Margate City, 9001 Winchester Avenue, Margate, NJ 08402.

Each bid shall be accompanied by a certified check, cashier's check or bid bond duly executed by the bidder as principal and having as surety thereon a surety company approved by the City of Margate City in an amount not less than ten percent (10%) but in no case in excess of $20,000.00 of the amount bid. Any such bid bond shall be without endorsement or conditions. Bid shall also be accompanied by a certificate letter from a surety company stating that it will provide the bidder with the completion bond.

The award of the contract shall be made subject to the necessary moneys to do the work being provided by the City of Margate City in a lawful manner. The contract to be executed by the successful bidder will provide that it shall not become effective until the necessary moneys to do the work have been provided by the City of Margate City in a lawful manner. The award shall further be subjected to the securing of necessary State, Federal or Local permits governing the work.

Bidders are required to comply with the requirements of N.J.S.A. 10:5-31 et seq., N.J.A.C. 17:27 (Affirmative Action), N.J.S.A. 34:11-56.25 et seq. (New Jersey Prevailing Wage Act), and Americans with Disabilities Act of 1990 (42 U.S.C. S12101, et.seq.).

The contractor is further notified that he must comply with N.J.S.A. 52:25-24.2, and submit a Disclosure Statement listing stockholders with his bid.

The contractor is further notified that he must comply with N.J.S.A. 34:11-56.48 et seq. Public Works Contractor Registration Act and he and any subcontractors must be registered in accordance with the act.

The contractor is also further notified that he must comply with N.J.S.A. 52:32-44 and submit proof of business registration and submit proof of business registration for any named subcontractors in accordance with the act.

By Order of the Board of Commissioners
Johanna Casey, R.M.C., City Clerk

PROPOSAL SECTION

(FORMS TO BE COMPLETED AND SUBMITTED WITH THE BID)

PROPOSAL SECTION

BID DOCUMENT SUBMISSION CHECKLIST

City of Margate City
(Name of Local Contracting Unit)

Public Works Building — 0116U200
(Name of Project) — (Project or Bid Number)

A. Failure to submit the following documents is a mandatory cause for the bid to be rejected. (N.J.S.A. 40A:11-23.2)

Required with Submission of Bid (Owner's checkmarks)		Initial Each Item Submitted With Bid (Bidder's Initials)
X	Bidder's acknowledgement of receipt of any notice(s) or revision(s) or addenda to an advertisement, specifications or bid document(s)	
X	A statement of ownership disclosure, pursuant to N.J.S.A. 52:25-24.2 (Stockholders Statement)	
X	A listing of subcontractors as required by N.J.S.A. 40A:11-16 (Subcontractor's Declaration)	
X	A bid guarantee as required by N.J.S.A. 40A:11-21 (Bid Bond, Certified Check or Cashier's Check)	
X	A certificate from a surety company, pursuant to N.J.S.A. 40A:11-22 (Consent of Surety)	

B. Failure to submit the following documents may be a cause for the bid to be rejected. (N.J.S.A. 40A:11-23.1b.)

Required with Submission of Bid (Owner's checkmarks)		Initial Each Item Submitted With Bid (Bidder's Initials)
X	Public Works Contractor Registration Form	
X	New Jersey "Business Registration Certificate" Form	
X	Background Questionnaire	
X	Debarred List Affidavit	
X	Submission of a Non-Collusion Affidavit (this form must be notarized)	
X	Affirmative Action Requirements	
X	Bidder Certificate showing ability to perform contract, pursuant to N.J.S.A. 40A:11-20	

	Disclosure of Investment Activities in Iran, pursuant to P.L. 2012, c. 25.	
	Prohibited Russia-Belarus Activities pursuant to P.L. 2022, c. 3.	
	Certification on Non-Debarment for Federal Government Contracts Form, pursuant to N.J.S.A. 52:32-44.1	
	Lowest Bidder Prevailing Wage Certification pursuant to N.J.S.A. 34:11-56.25, et seq., N.J.A.C. 12.60-9.1	
X	Bid Form	

C. Owner's Statement with respect to N.J.S.A. 40:11-23.1c: See technical specifications whether uniformed law enforcement officers will or will not be required for traffic control.

D. SIGNATURE: The undersigned hereby acknowledges and has submitted the above listed requirements.

Name of Bidder: _____

By Authorized Representative:

Signature: _____

Print Name and Title: _____

Date: _____

Company Name: _____

Mailing Address: _____

Physical Address: _____

Phone Number : _____

Fax Number: _____

E-Mail: _____

ACKNOWLEDGEMENT OF RECEIPT OF CHANGES TO BID DOCUMENTS FORM

City of Margate City
(Name of Local Contracting Unit)

Public Works Building — 0116U200__
(Name of Project) — (Project or Bid Number)

Pursuant to N.J.S.A. 40A:11-23.1a., the undersigned bidder hereby acknowledges receipt of the following notices, revisions, or addenda to the bid advertisement, specifications or bid documents. By indicating date of receipt, bidder acknowledges the submitted bid takes into account the provisions of the notice, revision or addendum. Note that the local unit's record of notice to bidders shall take precedence and that failure to include provisions of changes in a bid proposal may be subject for rejection of the bid.

Local Unit Reference Number Or Title of Addendum/Revision		How Received (mail, fax, pick-up, etc.)	Date Received	Bidder's Initials
Notice, Revision or Addenda No.	Title or Description			

Acknowledged by bidder:

Name of Bidder: _____

By Authorized Representative:

Signature: _____

Printed Name and Title: _____

Date: _____

STATEMENT OF OWNERSHIP DISCLOSURE

N.J.S.A. 52:25-24.2 (P.L. 1977, c.33, as amended by P.L. 2016, c.43)

This statement shall be completed, certified to, and included with all bid and proposal submissions. Failure to submit the required information is cause for automatic rejection of the bid or proposal.

Name of Organization: _____

Organization Address: _____

_____

Part I Check the box that represents the type of business organization:

☐ Sole Proprietorship (skip Parts II and III, execute certification in Part IV)
☐ Non-Profit Corporation (skip Parts II and III, execute certification in Part IV)
☐ For-Profit Corporation (any type) ☐ Limited Liability Company (LLC)
☐ Partnership ☐ Limited Partnership ☐ Limited Liability Partnership (LLP)
☐ Other (be specific): _____

Part II

☐ The list below contains the names and addresses of all stockholders in the corporation who own 10 percent or more of its stock, of any class, or of all individual partners in the partnership who own a 10 percent or greater interest therein, or of all members in the limited liability company who own a 10 percent or greater interest therein, as the case may be. (**COMPLETE THE LIST BELOW IN THIS SECTION**)

OR

☐ No one stockholder in the corporation owns 10 percent or more of its stock, of any class, or no individual partner in the partnership owns a 10 percent or greater interest therein, or no member in the limited liability company owns a 10 percent or greater interest therein, as the case may be. (**SKIP TO PART IV**)

(Please attach additional sheets if more space is needed):

Name of Individual or Business Entity	Address

Part III DISCLOSURE OF 10% OR GREATER OWNERSHIP IN THE STOCKHOLDERS, PARTNERS OR LLC MEMBERS LISTED IN PART II

If a bidder has a direct or indirect parent entity which is publicly traded, and any person holds a 10 percent or greater beneficial interest in the publicly traded parent entity as of the last annual federal Security and Exchange Commission (SEC) or foreign equivalent filing, ownership disclosure can be met by providing links to the website(s) containing the last annual filing(s) with the federal Securities and Exchange Commission (or foreign equivalent) that contain the name and address of each person holding a 10% or greater beneficial interest in the publicly traded parent entity, along with the relevant page numbers of the filing(s) that contain the information on each such person. **Attach additional sheets if more space is needed**.

Website (URL) containing the last annual SEC (or foreign equivalent) filing	Page #'s

Please list the names and addresses of each stockholder, partner or member owning a 10 percent or greater interest in any corresponding corporation, partnership and/or limited liability company (LLC) listed in Part II **other than for any publicly traded parent entities referenced above**. The disclosure shall be continued until names and addresses of every noncorporate stockholder, and individual partner, and member exceeding the 10 percent ownership criteria established pursuant to N.J.S.A. 52:25-24.2 has been listed. **Attach additional sheets if more space is needed.**

Stockholder/Partner/Member and Corresponding Entity Listed in Part II	Address

Part IV Certification

I, being duly sworn upon my oath, hereby represent that the foregoing information and any attachments thereto to the best of my knowledge are true and complete. I acknowledge: that I am authorized to execute this certification on behalf of the bidder/proposer; that the **City of Margate City** is relying on the information contained herein and that I am under a continuing obligation from the date of this certification through the completion of any contracts with the **City** to notify the **City** in writing of any changes to the information contained herein; that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I am subject to criminal prosecution under the law and that it will constitute a material breach of my agreement(s) with the, permitting the **City** to declare any contract(s) resulting from this certification void and unenforceable.

Full Name (Print):		Title:	
Signature:		Date:	

SUBCONTRACTOR DECLARATION

Each bidder shall set forth in the bid the names, addresses and license number (when required) of each subcontractor for the furnishing of plumbing, and gas fitting and all kindred work, and of the steam power plants, steam and hot water heating and ventilating and refrigeration apparatus and all kindred work, steam power plants and kindred work, and electrical work, including any electrical power plants, tele-data, fire alarm, or security system, and structural steel and ornamental iron work, if any, for the construction, alteration or repair of any public buildings.

A general contractor that intends to utilize a specific subcontractor to perform work in one or more of the specialty trade categories shall provide the required information with regard to that subcontractor in the appropriate space for each specialty trade category applicable to the contract

Whenever a bid sets forth more than one subcontractor for any of the categories listed below, the bidder shall submit to the contracting unit a certificate signed by the bidder listing each subcontractor named in the bid for that category. The certificate shall set forth the scope of work, goods and services for which the subcontractor has submitted a price quote and which the bidder has agreed to award to each subcontractor should the bidder be awarded the contract. The certificate shall be submitted to the contracting unit simultaneously with the list of the subcontractors. The certificate may take the form of a single certificate listing all subcontractors or, alternatively, a separate certificate may be submitted for each subcontractor. If a bidder does not submit a certificate or certificates to the contracting unit, the contracting unit shall award the contract to the next lowest responsible bidder.

All bidders seeking to perform plumbing work on a publicly bid contract are required to comply with N.J.S.A. 45:14C-2 and N.J.A.C. 13:32-1.3. These provisions require that plumbing work on such contract may only be performed by an entity in which a licensed master plumber owns not less than 10% of the issued and outstanding shares of stock in the corporation, or not less than 10% of the capital of the partnership, or not less than 10% of the ownership of any other firm or legal entity. Accordingly, if a bidder intends to perform plumbing work on a publicly bid contract with its own employees or by the bidder himself, a master plumber must possess an ownership interest that complies with N.J.S.A. 45:14C-2 and N.J.A.C. 13:32-1.3 in the entity submitting the bid. Alternately, if a bidder intends to perform such work through a subcontractor, a master plumber must possess an ownership interest that complies with N.J.S.A. 45:14C-2 and N.J.A.C. 13:32-1.3 in the subcontractor.

There shall be submitted proof that each subcontractor is qualified in accordance with the rules and regulations of the State of New Jersey when such rules and regulations exist.

A general contractor that intends to perform work in one or more of the specialty trade categories through the use of its own employees or the general contractor himself rather than through the utilization of a subcontractor shall write the word "**IN-HOUSE**" next to each applicable category and then insert the name, and license number where required, of each such employee of the general contractor or the general contractor himself in the appropriate spaces for each specialty trade category applicable to the contract.

If the contract does not involve the any of the specialty trade categories below, please insert the word "**NONE**" in each appropriate space provided.

Plumbing Work: _____

Name _____ Phone # _____
Address _____
License Number: _____

Gas Fitting and All Kindred Work: _____

Name _____ Phone # _____
Address _____
License Number: _____
Certification Number (for Medical Gas Piping Installation): _____

Steam Power Plants, Steam and Hot Water Heating and Ventilating and Refrigeration Apparatus and all Kindred Work:

Name _____ Phone # _____
Address _____
License Number: _____

Electrical Work, including any Electrical Power Plants_____

Name _____ Phone #_____
Address _____
License Number:_____

Tele-data Systems:_____

Name _____ Phone #_____
Address _____
License Number:_____
Telecommunications Exemption (Provide copy of letter and ID card) Number:_____

Fire Alarm Systems:_____

Name _____ Phone # _____
Address _____
License Number: _____
Fire Protection Equipment Business or Fire Protection Contractor Business Permit Number:_____

Security Systems:_____

Name _____ Phone # _____
Address _____
License Number: _____

Structural Steel and Ornamental Iron Work:

Name _____ Phone # _____
Address _____
License Number: Not Applicable

BID SECURITY

Attach bid bond, cashier's check or certified check in the amount of 10% of the bid, but not in excess of $20,000.00.

CONSENT OF SURETY

Attach Consent of Surety from a Surety Company, meeting the requirements, described herein, stating that if the bidder is awarded the contract that the surety company will supply the bonds for the contract.

1. Must be an irrevocable, unconditional commitment by the surety to issue on behalf of the bidder the bond or bonds set forth in the contract documents upon award of the project in the full amounts specified.
2. Must include all bonds required by the contract documents i.e. performance, labor and material payment, maintenance, environmental, etc.
3. Certificate (Consent) of Surety is not waiveable and will be considered a material defect resulting in rejection of bid if omitted from bid package.
4. Must not contain any provision that would serve to limit the surety's liability to the "spread to second" bidder in the event the bidder fails to enter into a contract upon award.

Sample wording is as shown below:

CONSENT OF SURETY

KNOW ALL MEN BY THESE PRESENTS, that for and consideration of the sum of $_____, lawful money of the United States of America, the receipt whereof is hereby acknowledged, paid the undersigned, and for other valuable consideration, the

SAMPLE

_____ Insurance Company,
(Name)

_____
(Address)

existing under the laws of the State of New Jersey and licensed to do business in the State of New Jersey certifies and agrees, that if the contract for (Contracting Agency)_____
for: (Project)_____
is awarded to (Bidder)_____
the undersigned will execute the bond or bonds as required of the contract documents and will become Surety in the full amount set forth in the contract documents for the faithful performance of all obligations of the Bidder, provided however, that this commitment shall expire sixty (60) days from the bid opening, unless agreed upon by Bidder, Owner and Surety to be extended.

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

_____ INSURANCE COMPANY
(Name)

By _____
(Name)
Attorney in Fact

(To be accompanied by the usual proof of Authority of Officers of officers of the Surety Company to execute same)

PUBLIC WORKS CONTRACTOR REGISTRATION FORM

N.J.S.A. 34:11-56.48 requires that contractors and subcontractors, be registered with the New Jersey Department of Labor, Division of Wage and Hour Compliance. The definition in the law is as follows:

"Contractor means a person, partnership, association, joint stock company, trust, corporation, or other legal business entity or successor thereof who enters into a contract which is subject to the provisions of the "New Jersey Prevailing Wage Act, N.J.S.A. 34:11-56.25 et seq. and includes any subcontractor or lower tier subcontractor of a contractor as defined herein."

1. All named contractors in a bid proposal (including out-of-state contractors) must be registered with the Department of Labor's Division of Wage and Hour Compliance at the time proposals are received by the public entity.
2. All named sub-contractors must be registered with the Department of Labor pursuant to the PWCRA at the time the proposal is received, or the proposal will be determined to be non-responsive.
3. Any non-listed sub-contractor must be registered with the Department of Labor prior to physically starting work.
4. The law requires contractors to submit certificates after a bid proposal is received and prior to awarding the contract. (N.J.S.A. 34:11-56.55)
5. After bid proposals are received, and prior to contract award, the contractor must submit to the public entity copies of certifications of all listed sub-contractors.
6. Prior to the work being performed by non-listed subcontractors, the contractor must submit to the public entity copies of certifications of all non-listed subcontractors.

Please indicate below, for the bidder and all subcontractors listed on the "Subcontractor Declaration" herein, as to their registration with the NJ Department of Labor, Division of Wage and Hour Compliance in accordance with N.J.S.A. 34:11-56.48.

Name	Not Registered	Registration Number
Bidder_____	___	_____
(Subcontractor)_____	___	_____
(Subcontractor)_____	___	_____
(Subcontractor)_____	___	_____
(Subcontractor)_____	___	_____

Subscribed and sworn
before me this _____ day
of _____ 20 ___.

_____ _____
Signature

Notary Public of _____ _____
Name and Title

My Commission Expires _____, 20_____. (Type or Print)
(Seal)

NEW JERSEY "BUSINESS REGISTRATION CERTIFICATE" FORM

N.J.S.A. 52:32-44 requires that Business Organization's, be registered with the New Jersey Department of Treasury, Division Revenue. The definition in the law is as follows:

""Contractor" means a business organization that seeks to enter, or has entered into, a contract with a contracting agency;

"Contract" means any agreement, including but not limited to a purchase order or a formal agreement for the provision of goods, performance of services, or construction of a construction project, which is a legally binding relationship enforceable by law, between a contractor and a contracting agency that agrees to compensate the contractor, as defined by and subject to the terms and conditions of the agreement; and where the goods that are received, services that are delivered, and construction that is constructed is within the geographic borders of the State of New Jersey; and where:

(1) the value of a single contract with the contractor is in excess of 15 percent of the amount of the contracting agency's bid threshold; or

(2) when the aggregate amount of contracts with the contractor, during the fiscal year of the contracting agency, exceeds 15 percent of the amount of the contracting agency's bid threshold.

Please indicate below, for the bidder and all subcontractors listed on the "Subcontractor Declaration" herein, as to their registration with the NJ Department of Treasury, Division of Revenue in accordance with N.J.S.A. 52:32-44.

The contractor shall provide the contracting agency with the business registration certificate of the contractor and that of any named subcontractor prior to the time a contract, purchase order, or other contracting document is awarded or authorized.

Name	Not Registered	Registration Number
Bidder_____	___	_____
(Subcontractor)_____	___	_____
(Subcontractor)_____	___	_____
(Subcontractor)_____	___	_____
(Subcontractor)_____	___	_____

Subscribed and sworn
before me this _____ day
of _____ 20 ___.

_____ _____
Signature

Notary Public of _____ _____
Name and Title

My Commission Expires _____, 20_____. (Type or Print)
(Seal)

BACKGROUND QUESTIONNAIRE

In accordance with paragraph entitled "Qualifications of Bidders" of "Information for Bidders", provide the following information:

Date of Organization of Company _____

Name and address of officers: _____

President _____
Vice President _____
Secretary _____
Treasurer _____

EXPERIENCE

1. How many years has your organization been in business as a general contractor under your present business name? _____

2. How many years experience in this type of construction work has your organization had? _____

3. What are the latest projects (within the last five years) your organization has completed? (Attach additional pages if necessary)

	Contract Amount	Date Work Completed	For Whom
A.	$_____	_____	_____
B.	$_____	_____	_____
C.	$_____	_____	_____
D.	$_____	_____	_____
E.	$_____	_____	_____

Names, Addresses and Telephone Numbers of Reference for items listed above:

	Name and Address	Telephone No.
A.	_____	_____
B.	_____	_____
C.	_____	_____

	Name and Address	Telephone No.
D.	_____	_____
E.	_____	_____

4. Have you ever failed to complete any work awarded to you (within the last ten years)?_____
If so, where and why?_____
_____

5. Have you or has any officer of your organization ever been an officer or partner of some other contracting organization that failed to complete any work (within the last ten years) ?_____
If so, state the name of individual, position and the name of the other organization
_____

_____

Did this other contracting organization ever fail to complete any work awarded it (within the last ten years)? _____
If so, where and why?_____

6. Give list of uncompleted contracts at present held by you:

Name of Contract	Contracting Agency	Amount
_____		$_____
_____		$_____
_____		$_____

Name of Contract	Contracting Agency	Amount
_____		$_____
_____		$_____

7. State approximately the largest amount of work you have done in any one year (within the last five years) of a similar nature to the work being bid on.

_____

_____

8. List the equipment available for the performance of work under the proposed contract (attach additional sheets if necessary)

_____

_____

_____

_____

_____

_____

DEBARRED LIST AFFIDAVIT

STATE OF _____

COUNTY OF _____ ss:

I, _____ of the City/Town/Township/Borough, etc. _____ in the County of _____ and the State of _____full age, being duly sworn according to law on my oath depose and say that:
I am _____ an officer of the firm of _____ _____ the bidder making the bid for the above named work, and that I executed said bid with full authority to do so; that said bidder at the time of making of this bid is not debarred at the federal level from contracting with a federal government agency as indicated in N.J.S.A. 52:32-44.1 or included on the State of New Jersey, State Treasurer's List of Debarred, Suspended and Disqualified Bidders; and that all statements contained in said bid and in this affidavit are true and correct, and made with the full knowledge that the City of Margate City, as the Owner relies upon the truth of the statements contained in said bid and in the
(name of the contracting agency)
statements contained in this affidavit in awarding the contract for said work.

The undersigned further warrants that should the name of the firm making this bid be debarred at the federal level from contracting with a federal government agency or appear on the State Treasurer's List of Debarred, Suspended and Disqualified Bidders at anytime prior to, and during the life of this Contract, including Guarantee Period, that the Local Unit shall be immediately so notified by the signatory of this Eligibility Affidavit.

The undersigned understands that the firm making the bid as Contractor is subject to debarment, suspension and/or disqualification in contracting with the State of New Jersey, if the Contractor, pursuant to N.J..A.C. 12:60-7.1 et seq., commits any of the acts listed therein, and as determined according to applicable law and regulation.

_____

_____

_____
(Insert Name, Telephone No., Fax No. and Address of Contractor)

_____
(Insert Name and Title of Affiant)

Subscribed and sworn
before me this _____ day
of _____ 20 __ .

_____

Notary Public of _____

My Commission Expires _____ , 20 ___.
(Seal)

NON-COLLUSION AFFIDAVIT

STATE OF _____

COUNTY OF _____ ss:

I, _____ of the (City, Town, Township, Borough, etc.)

of _____ in the County of _____ and the

State of _____, of full age, being duly sworn

according to law on my oath depose and say that:

I am _____
of the firm of _____
the bidder making the Proposal for the above named project, and that I executed the said Proposal with full authority to do so; that said bidder had not, directly or indirectly, entered into any agreement(s), participated in any collusion, or otherwise taken any action in restraint of free, competitive bidding in connection with the above named project; and that all statements contained in said Proposal and in this affidavit are true and correct, and made with full knowledge that the _City of Margate City relies upon the truth of the statements contained in said Proposal and in this affidavit
(name of contracting agency)
in awarding the contract for the said Project.

I further warrant that no person(s) or selling agency has been employed or retained to solicit, or secure such contract upon an agreement or understanding for a commission, percentage, brokerage or contingent, fee except bona fide employees or bona fide established commercial or selling agencies maintained by

_____.
(name of bidder)

_____

_____

_____
(Insert Name, Telephone No., Fax No. and Address of Contractor)

_____
(Insert Name and Title of Affiant)

Subscribed and sworn
before me this _____ day
of _____ 20 __ .

_____

Notary Public of _____

My Commission Expires _____ , 20 ___.
(Seal)

AFFIRMATIVE ACTION REQUIREMENTS

CONSTRUCTION CONTRACTS

"Bidder is required to comply with the requirements of N.J.S.A. 10:5-31 et seq. and N.J.A.C. 17:27.

1. All successful contractor(s) must submit, to the agencies named below, after notification of award but prior to the signing of the contract an Initial Project Workforce Report (Form AA201) for any contract award that meets or exceeds the Public Agency bidding threshold.

2. The successful contractor(s) must submit the appropriate copies of the Initial Project Workforce Report (Form AA201) to the Division of Contract Compliance and the appropriate copy to the Public Agency.

3. The successful contractor(s) must submit a copy of the Monthly Workforce Report (Form AA 202) once a month thereafter for the duration of this contract to the Division and to the public agency compliance officer.

The undersigned certifies that he/she is aware of the commitment to comply with the requirements of N.J.S.A. 10:5-31 et seq. and N.J.A.C. 17:27 and agrees to furnish the required forms of evidence.

The undersigned further understands that his/her bid may be rejected as non-responsive if the requirements of N.J.S.A. 10:5-31 et seq. and N.J.A.C. 17:27 are not complied with.

_____

_____

_____
(Insert Name, Telephone No., Fax No. and Address of Contractor)

_____
(Insert Name and Title of Affiant)

Subscribed and sworn
before me this _____ day
of _____ 20 __ .

_____

Notary Public of _____

My Commission Expires _____ , 20 ___.
(Seal)

CERTIFICATE OF BIDDER SHOWING ABILITY TO PERFORM CONTRACT

STATE OF _____

COUNTY OF _____ ss:

I, _____ of the (City, Town, Township, Borough, etc.)

of _____ in the County of _____ and the

State of _____ of full age, being duly sworn

according to law on my oath depose and say that:

1. I am a(n) owner, partner, shareholder or officer of the company set forth below and am duly authorized to execute this affidavit on its behalf.

(Check appropriate Statement(s))

_____ I own, lease or control the necessary equipment required by the plans, specifications, and advertisements under which bids are asked for.

_____ I do not own, lease or control all the necessary equipment required by the plans, specifications, and advertisements under which bids are asked for.
If the bidder is not the actual owner or lessee of all the necessary equipment provide the source from which the equipment will be obtained (Attach additional sheets if necessary)

_____

_____

_____

(Attach certification from the owner or person in control of the equipment definitely granting to the bidder the control of the equipment required during such time as may be necessary for the completion of that portion of the contract for which it is necessary)

_____

_____

_____
(Insert Name, Telephone No., Fax No. and Address of Contractor)

_____
(Insert Name and Title of Affiant)

Subscribed and sworn
before me this _____ day
of _____ 20 __ .

_____

Notary Public of _____

My Commission Expires _____ , 20 ___.
(Seal)

Disclosure of Investment Activities in Iran	
Person or Entity	

Part 1: Certification

COMPLETE PART 1 BY CHECKING **EITHER BOX**.

Pursuant to Public Law 2012, c. 25, any person or entity that is a successful bidder or proposer, or otherwise proposes to enter into or renew a contract, must complete the certification below to attest, under penalty of perjury, that neither the person or entity, nor any parent entity, subsidiary, or affiliate is identified on the State Department of Treasury's Chapter 25 list as a person or entity engaging in investment activities in Iran. The list is found on Treasury's website at www.state.nj.us/treasury/purchase/pdf/Chapter25List.pdf.

The Chapter 25 list must be reviewed prior to completing the below certification. If a vendor or contractor is found to be in violation of law, action may be taken as appropriate and as may provided by law, rule or contract, including but not limited to imposing sanctions, seeking compliance, recovering damages, declaring the party in default and seeking debarment or suspension of the party.

☐	*I certify, pursuant to Public Law 2012, c. 25, that neither the person or entity listed above, nor any parent entity, subsidiary, or affiliate thereof is listed on the N.J. Department of the Treasury's list of entities determined to be engaged in prohibited activities in Iran pursuant to P.L. 2012, c. 25 ("Chapter 25 List"). I further certify that I am the person listed above, or I am an officer or representative of the entity listed above and am authorized to make this certification on its behalf. I will skip Part 2 and sign and complete the Certification below.*
OR	
☐	*I am unable to certify as above because the person or entity and/or a parent entity, subsidiary, or affiliate thereof is listed on the N.J. Department of the Treasury's Chapter 25 list. I will provide a detailed, accurate and precise description of the activities in Part 2 below sign and complete the Certification below.*

Part 2: Additional Information

PLEASE PROVIDE FURTHER INFORMATION RELATED TO INVESTMENT ACTIVITIES IN IRAN.

You must provide a detailed, accurate and precise description of the activities of the person or entity, or a parent entity, subsidiary, or affiliate thereof engaging in investment activates in Iran below and, if more space is needed, on additional sheets provided by you.

Part 3: Certification of True and Complete Information

I, being duly sworn upon my oath, hereby represent and state that the foregoing information and any attachments there to the best of my knowledge are true and complete. I attest that I am authorized to execute this certification on behalf of the above-referenced person or entity.

I acknowledge that the **City of Margate City** *is relying on the information contained herein and thereby acknowledge that I am under a continuing obligation from the date of this certification through the completion of any contracts with the* ***City of Margate City*** *to notify the* ***City of Margate City*** *in writing of any changes to the answers of information contained herein.*

I acknowledge that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I recognize that I am subject to criminal prosecution under the law and that it will also constitute a material breach of my agreement(s) with the ***City of Margate City*** *and that the* ***City of Margate City*** *at its option may declare any contract(s) resulting from this certification void and unenforceable.*

Full Name (Print)		**Title**	
Signature		**Date**	

CERTIFICATION OF NON-INVOLVEMENT IN PROHIBITED ACTIVITIES IN RUSSIA OR BELARUS

Pursuant to N.J.S.A. 52:32-60.1, et seq. (L. 2022, c. 3) any person or entity (hereinafter "Vendor[i]") that seeks to enter into or renew a contract with a State agency for the provision of goods or services, or the purchase of bonds or other obligations, must complete the certification below indicating whether or not the Vendor is identified on the Office of Foreign Assets Control (OFAC) Specially Designated Nationals and Blocked Persons list, available here: https://sanctionssearch.ofac.treas.gov/. If the Department of the Treasury finds that a Vendor has made a certification in violation of the law, it shall take any action as may be appropriate and provided by law, rule or contract, including but not limited to, imposing sanctions, seeking compliance, recovering damages, declaring the party in default and seeking debarment or suspension of the party.

I, the undersigned, certify that I have read the definition of "Vendor" below, and have reviewed the Office of Foreign Assets Control (OFAC) Specially Designated Nationals and Blocked Persons list, and having done so certify:

(Check the Appropriate Box)

○ A. That the Vendor is not identified on the OFAC Specially Designated Nationals and Blocked Persons list on account of activity related to Russia and/or Belarus.

OR

○ B. That I am unable to certify as to "A" above, because the Vendor is identified on the OFAC Specially Designated Nationals and Blocked Persons list on account of activity related to Russia and/or Belarus.

OR

○ C. That I am unable to certify as to "A" above, because the Vendor is identified on the OFAC Specially Designated Nationals and Blocked Persons list. However, the Vendor is engaged in activity related to Russia and/or Belarus consistent with federal law, regulation, license or exemption. A detailed description of how the Vendor's activity related to Russia and/or Belarus is consistent with federal law is set forth below.

_____

_____

_____

_____

_____

_____

(*Attach Additional Sheets If Necessary.)*

Signature of Vendor's Authorized Representative	Date
Print Name and Title of Vendor's Authorized Representative	Vendor's FEIN
Vendor's Name	Vendor's Phone Number
Vendor's Address (Street Address)	Vendor's Fax Number
Vendor's Address (City/State/Zip Code)	Vendor's Email Address

[i] Vendor means: (1) A natural person, corporation, company, limited partnership, limited liability partnership, limited liability company, business association, sole proprietorship, joint venture, partnership, society, trust, or any other nongovernmental entity, organization, or group; (2) Any governmental entity or instrumentality of a government, including a multilateral development institution, as defined in Section 1701(c)(3) of the International Financial Institutions Act, 22 U.S.C. 262r(c)(3); or (3) Any parent, successor, subunit, direct or indirect subsidiary, or any entity under common ownership or control with, any entity described in paragraph (1) or (2).

CERTIFICATION OF NON-DEBARMENT
FOR FEDERAL GOVERNMENT CONTRACTS
N.J.S.A. 52:32-44.1 (P.L. 2019, c.406)

This certification shall be completed, certified to, and submitted to the contracting unit prior to contract award, except for emergency contracts where submission is required prior to payment.

PART I: VENDOR INFORMATION	
Individual or Organization Name	
Address of Individual or Organization	
Unique Entity ID (if applicable)	
CAGE Code (if applicable)	
Check the box that represents the type of business organization:	

□Sole Proprietorship (skip Parts III and IV) □Non-Profit Corporation (skip Parts III and IV)

□For-Profit Corporation (any type) □Limited Liability Company (LLC) □Partnership

□Limited Partnership □Limited Liability Partnership (LLP)

□Other (be specific): _____

PART II – CERTIFICATION OF NON-DEBARMENT: Individual or Organization			
I hereby certify that the **individual or organization listed above in Part I** is not debarred by the federal government from contracting with a federal agency. I further acknowledge: that I am authorized to execute this certification on behalf of the above-named organization; that the **City of Margate City** is relying on the information contained herein and that I am under a continuing obligation from the date of this certification through the date of contract award by the **City** to notify the **City** in writing of any changes to the information contained herein; that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I am subject to criminal prosecution under the law and that it will constitute a material breach of my agreement(s) with the **City** permitting the **City** to declare any contract(s) resulting from this certification void and unenforceable.			
Full Name (Print):		Title:	
Signature:		Date:	

PART III – CERTIFICATION OF NON-DEBARMENT: Individual or Entity Owning Greater than 50 Percent of Organization	
Section A (Check the Box that applies)	
☐	Below is the name and address of the stockholder in the corporation who owns more than 50 percent of its voting stock, or of the partner in the partnership who owns more than 50 percent interest therein, or of the member of the limited liability company owning more than 50 percent interest therein, as the case may be.
Name of Individual or Organization	
Physical Address	
OR	
☐	No one stockholder in the corporation owns more than 50 percent of its voting stock, or no partner in the partnership owns more than 50 percent interest therein, or no member in the limited liability company owns more than 50 percent interest therein, as the case may be.
Section B (Skip if no Business entity is listed in Section A above)	
☐	Below is the name and address of the stockholder in the corporation who owns more than 50 percent of the voting stock of the organization's parent entity, or of the partner in the partnership who owns more than 50 percent interest in the organization's parent entity, or of the member of the limited liability company owning more than 50 percent interest in organization's parent entity, as the case may be.
Stockholder/Partner/Member Owning Greater Than 50 Percent of Parent Entity	
Physical Address	
OR	
☐	No one stockholder in the parent entity corporation owns more than 50 percent of its voting stock, no partner in the parent entity partnership owns more than 50 percent interest therein, or no member in the parent entity limited liability company owns more than 50 percent interest therein, as the case may be.

Section C – Part III Certification			
I hereby certify that no individual or organization that is debarred by the federal government from contracting with a federal agency owns greater than 50 percent of the **Organization listed above in Part I** or, if applicable, owns greater than 50 percent of a parent entity of _____. (**name of organization**) I further acknowledge: that I am authorized to execute this certification on behalf of the above-named organization; that the **City of Margate City** is relying on the information contained herein and that I am under a continuing obligation from the date of this certification through the date of contract award by the **City** to notify the **City** in writing of any changes to the information contained herein; that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I am subject to criminal prosecution under the law and that it will constitute a material breach of my agreement(s) with the **City** permitting the **City** to declare any contract(s) resulting from this certification void and unenforceable.			
Full Name (Print):		Title:	
Signature:		Date:	

Part IV – CERTIFICATION OF NON-DEBARMENT: Contractor – Controlled Entities		
Section A		
□	Below is the name and address of the corporation(s) in which the **Organization listed in Part I** owns more than 50 percent of voting stock, or of the partnership(s) in which the **Organization listed in Part I** owns more than 50 percent interest therein, or of the limited liability company or companies in which the **Organization listed above in Part I** owns more than 50 percent interest therein, as the case may be.	
Name of Business Entity		**Physical Address**
Add additional sheets if necessary		
OR		
□	The **Organization listed above in Part I** does not own greater than 50 percent of the voting stock in any corporation and does not own greater than 50 percent interest in any partnership or any limited liability company.	

Section B (skip if no business entities are listed in Section A of Part IV)	
☐	Below are the names and addresses of any entities in which an entity listed in Part III A owns greater than 50 percent of the voting stock (corporation) or owns greater than 50 percent interest (partnership or limited liability company).

Name of Business Entity Controlled by Entity Listed in Section A of Part IV	Physical Address

Add additional Sheets if necessary

OR	
☐	No entity listed in Part III A owns greater than 50 percent of the voting stock in any corporation or owns greater than 50 percent interest in any partnership or limited liability company.

Section C – Part IV Certification

I hereby certify that the **Organization listed above in Part I** does not own greater than 50 percent of any entity that that is debarred by the federal government from contracting with a federal agency and, if applicable, does not own greater than 50 percent of any entity that in turns owns greater than 50 percent of any entity debarred by the federal government from contracting with a federal agency. I further acknowledge: that I am authorized to execute this certification on behalf of the above-named organization; that the **City of Margate City** is relying on the information contained herein and that I am under a continuing obligation from the date of this certification through the date of contract award by the **City** to notify the **City** in writing of any changes to the information contained herein; that I am aware that it is a criminal offense to make a false statement or misrepresentation in this certification, and if I do so, I am subject to criminal prosecution under the law and that it will constitute a material breach of my agreement(s) with the **City**, permitting the **City** to declare any contract(s) resulting from this certification void and unenforceable.

Full Name (Print):		Title:	
Signature:		Date:	

LOWEST BIDDER PREVAILING WAGE CERTIFICATION

In the matter of an award of a contract for public work for a project described as:	)	STATE OF NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT DIVISION OF
Public Works Building	)	WAGE & HOUR COMPLIANCE
	)	Certification of Lowest Bidder

_____, of full age and under oath, duly provides the following sworn statement:

(1). I am the owner and/or highest-ranking official or officer of a company or firm named _____, which holds a currently valid public works contractor registration pursuant to the New Jersey Public Works Contractor Registration Act, N.J.S.A. 34:11-56.48 et seq., certificate number_____.

(2). I submitted a bid for a contract award in the above identified project and the public body has informed me that I am the lowest bidder by 10 percent or more as compared to the next lowest bid submitted.

(3). The amount of my bid does include paying the prevailing wage rate to all workers who perform work on the project at rates of pay, including both base wage and fringe benefits, set forth in applicable Wage Determinations, (1) for the appropriate locality, (2) for the appropriate work classification (e.g., carpenter, electrician, mason, plumber), and (3) for the appropriate job title (e.g., Apprentice, Journeyman, Forman), published by the New Jersey Department of Labor and Workforce Development (NJDOL) pursuant to the New Jersey Prevailing Wage Act (NJPWA), N.J.S.A. 34:11-56.25 et seq., and corresponding NJDOL rules, N.J.A.C. 12:60.

I certify under penalty of perjury that the foregoing statements made by me are true. I am aware that if any of the foregoing statements made by me are false, I am subject to punishment. See N.J.S.A. 2C:28-1 et seq., specifically, N.J.S.A. 2C:28-3, within the New Jersey Code of Criminal Justice.

Dated:_____ Signature:_____

Title: _____

BID FORM

Pursuant to and in accordance with your Advertisement for Bids and the Information for Bidders relating thereto, the undersigned hereby offers to furnish all plant, labor, materilas, supplies, equipment and other facilities and things necessary for, or proper for, or incidental to the Public Works Building, as required by, and in strict accordance with the applicable provisions of plans and specifications and all addenda issued by the Margate City or its Engineer prior to the date of opening the bids, whether received by the undersigned or not, for the amount bid based on the following unit and/or lump-sum prices:

NOTE: Extension of Unit Prices must be exact.

BASE BID

Item	Quantity	Units	Description	Unit Price	Amount
1	1	LS	NEW PUBLIC WORKS BUILDING, COMPLETE, WITHOUT FREIGHT ELEVATOR, AS SHOWN ON THE PLANS AND INDICATED IN THE SPECIFICATIONS	$	$
2	100,000	DOLLAR	ALLOWANCE	$ 1.00	$ 100,000.00

TOTAL AMOUNT BID , BASE BID Items #1 - #2, Inclusive $

TOTAL AMOUNT BID WRITTEN OUT, BASE BID, ITEMS #1-#2, INCLUSIVE

SIGNATURE **NAME & TITLE**

BID DATE **COMPANY NAME**

ADD ALTERNATE BID

Item	Quantity	Units	Description	Unit Price	Amount
3	1	LS	NEW PUBLIC WORKS BUILDING FREIGHT ELEVATOR,COMPLETE, AS SHOWN ON THE PLANS AND INDICATED IN THE SPECIFICATIONS	$	$

TOTAL AMOUNT BID, ADD ALTERNATE BID, ITEM #3 $

TOTAL AMOUNT BID WRITTEN OUT,ADD ALTERNATE BID, ITEM #3

SIGNATURE **NAME & TITLE**

BID DATE **COMPANY NAME**

ACKNOWLEDGEMENT OF CONTRACT TIME

The time to complete the work contracted for, from the date the Notice to Proceed is issued shall be limited to 330 Calendar Days for the base bid and any alternate bids awarded. No extension of time will be allowed for delay from any cause whatsoever, including normal weather conditions unless the Contractor shall have notified the Engineer in writing of such delay and his intention to claim an extension of time within two (2) days after the beginning of such delay. Such notice shall give complete information concerning the nature, extent and cause of the delay. If, in the opinion of the Owner, an extension of time is warranted the Owner or Owner's representative, will issue a written extension, setting a new time limit for the completion of the work.

_____
(Initial)

As set forth in the General Conditions, The Owner is only responsible for paying construction observation and contract administration costs during the contract time period. The contractor is responsible for all costs of construction observation and contract administration beyond the contract time limit. These costs are in addition to any liquidated damages that may be charged to the contractor.

_____
(Initial)

In case the Contractor fails to complete the work contracted for, satisfactory to and acceptable to the Owner within the stipulated time limit, or violates any terms or conditions of said contract or the terms and conditions of N.J.S.A. 40A:11-1 et seq. (Local Public Contracts Law), then the Contractor shall and will pay to the Owner for each and every calendar day determined to be in default, the following sums, which are agreed upon, fixed and determined by the parties hereto to be liquidated damages.

One (1) to Fifteen Days beyond contract time limits:
Five Hundred ($500.00) dollars per calendar day
Sixteen (16) to thirty (30) Days beyond contract time limits:
One Thousand ($1,000.00) dollars per calendar day
Greater than Thirty (30) Days beyond contract:
Two Thousand ($2,000.00) dollars per calendar day

_____
(Initial)

SIGNATURE **NAME & TITLE**

BID DATE **COMPANY NAME**

END PROPOSAL SECTION

TABLE OF CONTENTS
INFORMATION FOR BIDDERS

		PAGE NO.
1.0 BID PREPARATION		
1.01	Examination and Responsibility	IFB-1
1.02	Condition of Work	IFB-1
1.03	Obligations of Bidders	IFB-1
1.04	Addenda, Bid Specification Challenges and Interpretations	IFB-1
1.05	Qualifications of Bidders	IFB-2
1.06	Disclosure Statement N.J.S. A. 52:25-24.2	IFB-2
1.07	Manufactured Articles	IFB-2
1.08	Bid Security and Consent of Surety	IFB-3
1.09	New Jersey Business Registration Requirements	IFB-3
2.0 SUBMISSION OF BIDS		
2.01	General	IFB-4
2.02	Price to Include	IFB-4
2.03	Rejection of Bids	IFB-5
2.04	Award of Bid	IFB-5
3.0 CONTRACTS		
3.01	Drawings and Specifications Furnished	IFB-5
3.02	Performance, Payment and Maintenance Bonds	IFB-5
3.03	Laws and Regulations	IFB-6
3.04	Permits	IFB-6
3.05	Contract Documents	IFB-6
3.06	Notice to Proceed	IFB-6
4.0 AFFIRMATIVE ACTION AGAINST DISCRIMINATION		
4.01	Bidder Referred to Law	IFB-7
4.02	Specific Language Required	IFB-7
4.03	Contract Procedures	IFB-10
4.04	Equal Opportunity for Individuals with Disabilities	IFB-10
5.0 FORM OF CONTRACT		IFB-12
6.0 CERTIFICATE OF INSURANCE		IFB-14

INFORMATION FOR BIDDERS

1.0 BID PREPARATION

1.01 EXAMINATION AND RESPONSIBILITY

Bidders are directed to examine for themselves the drawings, specifications, estimated quantities and the location of the proposed work. They shall exercise their own judgment as to the scope and nature of the work; the difficulties to be encountered and the quantities that may actually be encountered in the work. Each bidder is fully responsible for having reviewed and understood these specifications previous to submitting his bid, that his bid covers and complies with all requirements of the Contract Documents, and shall not at any time thereafter assert any claim related to any misunderstanding of the nature or amount of work to be done.

1.02 CONDITION OF WORK

Each bidder must inform himself fully of the conditions relative to the construction under which the work is now being or will be performed. Failure to do so will not relieve a successful bidder of his obligation to furnish all materials and labor necessary to carry out the provisions of the contract documents and to complete the contemplated work for the construction as set forth in his bid. The Contractor in the carrying out of his work must employ such methods or means that will not cause any interruptions or interference with the work of any other contractor (if applicable).

1.03 OBLIGATIONS OF BIDDERS

At the time of the opening of bids each bidder will be presumed to have inspected the site and to have read and to be thoroughly familiar with the drawings and contract documents (including all addenda). The failure or omission of any bidder to receive or examine any form, instrument or documents, shall in no way relieve any bidder from any obligations contained therein.

1.04 ADDENDA, BID SPECIFICATION CHALLENGES AND INTERPRETATIONS

The Table of Contents indicates the number of pages of each section of the document. If any bidder finds that a page was miss-copied or is missing, please contact the Engineer. The page(s) will be faxed to the bidder. Issuance of any such pages will not be considered an Addendum to the contract or specifications.

No interpretations of the meaning of the drawings, specifications or other contract documents will be made to any bidder orally. Every request for such interpretation should be made in writing, addressed to the Engineer, and to be given consideration, must be received at least ten (10) days prior to the final date fixed for receiving bids. Any and all such interpretations and/or supplemental instructions will be in the form of written addenda to the specifications, which if issued, will be issued in accordance with applicable State Laws.

Any bidder who wishes to challenge a bid specification shall file such challenges in writing with the Engineer no less than three business days prior to the opening of the bids. Challenges filed after that time shall be considered void and having no impact on the contracting unit or the award of a contract.

Failure of any bidder to receive any such addendum or interpretations shall not relieve any bidder from any such obligations therein under his bid submitted. All addenda so issued shall become part of the contract documents, and shall be attached to the bid form when submitted

1.05 QUALIFICATIONS OF BIDDERS

The owner may make such investigation as is necessary to determine the responsibility of the bidder and/or the ability of the bidder to perform the work. The bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any bid if evidence submitted by, or investigation of, such bidder fails to satisfy the Owner that said bidder is responsible or properly qualified to carry out the obligations of the contract and to complete the work therein contemplated.

Conditional bids will not be accepted. Bids which are incomplete or obscure may be rejected at Owner's option.

1.06 DISCLOSURE STATEMENT N.J.S.A. 52:25-24.2

No corporation, partnership, or limited liability company shall be awarded any contract nor shall any agreement be entered into for the performance of any work or the furnishing of any materials or supplies, the cost of which is to be paid with or out of any public funds, by the State, or any county, municipality or school district, or any subsidiary or agency of the State, or of any county, municipality or school district, or by any authority, board, or commission which exercises governmental functions, unless prior to the receipt of the bid or accompanying the bid, of said corporation, said partnership, or said limited liability company there is submitted a statement setting forth the names and addresses of all stockholders in the corporation who own 10 percent or more of its stock, of any class, or of all individual partners in the partnership who own a 10 percent or greater interest therein, or of all members in the limited liability company who own a 10 percent or greater interest therein, as the case may be. If one or more such stock holder or partner or member is itself a corporation or partnership or limited liability company, the stockholders holding 10 percent or more of that corporation's stock, or the individual partners owning 10 percent or greater interest in that partnership, or the members owning 10 percent or greater interest in that limited liability company, as the case may be, shall also be listed. The disclosure shall be continued until names and addresses of every noncorporate stockholder, and individual partner, and member, exceeding the 10 percent ownership criteria established in this act, has been listed.

To comply with this section, a bidder with any direct or indirect parent entity which is publicly traded may submit the name and address of each publicly traded entity and the name and address of each person that holds a 10 percent or greater beneficial interest in the publicly traded entity as of the last annual filing with the federal Securities and Exchange Commission or the foreign equivalent, and, if there is any person that holds a 10 percent or greater beneficial interest, also shall submit links to the websites containing the last annual filings with the federal Securities and Exchange Commission or the foreign equivalent and the relevant page numbers of the filings that contain the information on each person that holds a 10 percent or greater beneficial interest.

1.07 MANUFACTURED ARTICLES

In the specifications and on accompanying drawings, there are specified and shown certain pieces of equipment and materials, deemed most suitable for the service anticipated. This is not done, however, to eliminate other equipment and materials equally as good and efficient. When a bidder submits an equivalent, it shall be the responsibility of the bidder to document the equivalence claim. Failure to submit such documentation shall be grounds for the rejection of the claim of equivalence. The bidder shall prepare his bid on the basis of the particular equipment and materials specified or shown, and shall be responsible for the coordination, arrangement and location of all equipment and material incorporated in the work.

1.08 BID SECURITY AND CONSENT OF SURETY

Each bid shall be accompanied by a Certified Check, Cashier's Check or Bid Bond duly executed by the bidder as principal, and having as surety thereon a Surety Company approved by the Owner, in an amount not less than ten percent (10%) of the amount bid but in no case in excess of $20,000.00. Any such Bid Bond shall be without endorsement or conditions. Bid shall also be accompanied with a certificate letter from a surety company stating that it will provide the bidder with the requisite completion performance and payment bonds**,** i.e. a Consent of Surety.

Such bid guarantee will be returned to all bidders, except to the three apparent lowest responsible bidders, within ten days after the formal opening of bids, Sundays and holidays, excepted.

The bid guarantee will be returned to the remaining unsuccessful bidders within three days, Sundays and holidays excepted, after the Owner and the accepted bidder have executed the contract and the Owner has approved the Bidder's Performance Bond, or if no contract has been accepted within 60 days after the date of opening of bids, any bidder upon demand made after the expiration of said 60 day period, shall be entitled to the return of his bid guarantee, so long as he has not been notified by the Owner of the acceptance of his bid.

Any such bid guarantee shall be forfeited and become the property of the Owner if the bidder whose bid is accepted shall fail: to give a satisfactory performance bond and labor and material payment bond, or a combination performance and labor and material payment bond, and/or fails to execute a contract within ten (10) days after notice from the Owner to do so.

1.09 NEW JERSEY BUSINESS REGISTRATION REQUIREMENTS

Pursuant to N.J.S.A. 52:32-44, Contracting Agency is prohibited from entering into a contract with an entity unless the bidder/proposer/contractor, and each subcontractor that is required by law to be named in a bid/proposal/contract has a valid Business Registration Certificate on file with the Division of Revenue and Enterprise Services within the Department of the Treasury.

Prior to contract award or authorization, the contractor shall provide the Contracting Agency with its proof of business registration and that of any named subcontractor(s).

Subcontractors named in a bid or other proposal shall provide proof of business registration to the bidder, who in turn, shall provide it to the Contracting Agency prior to the time a contract, purchase order, or other contracting document is awarded or authorized.

During the course of contract performance:

(1) the contractor shall not enter into a contract with a subcontractor unless the subcontractor first provides the contractor with a valid proof of business registration.
(2) the contractor shall maintain and submit to the Contracting Agency a list of subcontractors and their addresses that may be updated from time to time.
(3) the contractor and any subcontractor providing goods or performing services under the contract, and each of their affiliates, shall collect and remit to the Director of the Division of Taxation in the Department of the Treasury, the use tax due pursuant to the Sales and Use Tax Act, (N.J.S.A. 54:32B-1 et seq.) on all sales of tangible personal property delivered into the State. Any questions in this regard can be directed to the Division of Taxation at (609)292-6400. Form NJ-REG can be filed online at http://www.state.nj.us/treasury/revenue/busregcert.shtml.

Before final payment is made under the contract, the contractor shall submit to the Contracting Agency a complete and accurate list of all subcontractors used and their addresses.

Pursuant to N.J.S.A. 54:49-4.1, a business organization that fails to provide a copy of a business registration as required, or that provides false business registration information, shall be liable for a penalty of $25 for each day of violation, not to exceed $50,000, for each proof of business registration not properly provided under a contract with a contracting agency.

2.0 SUBMISSION OF BIDS

2.01 GENERAL

Bidder must submit their bid on the respective "Bid Form and Package" included hereto.

No bid will be accepted or opened if received after the designated time for receipt.

For each bid made, all blank spaces in the Bid Form must be filled in, in ink, with the unit prices of the item and its extension. All bid forms submitted will be checked for arithmetic accuracy. In the event of a discrepancy between the unit price bid for any Pay Item and the extension shown for that item under the column of the Proposal Form designated "Amount," the unit price is to govern. Where a unit price is bid for a Pay Item, but no extension is provided, the Owner will provide the extension based on the unit price bid and the estimated quantity for that Pay Item. Where an extension is provided by the Bidder in the "Amount" column, but no unit price appears in the "Unit Price" column of the Proposal Form, the Owner will provide the unit price by dividing the "Amount" figure provided by the Bidder by the estimated quantity.

Award will be made on the basis of Total Contract Price. The Total Contract Price means the correctly determined summation of lump sum bids and products of all quantities for Pay Items shown in the Proposal form multiplied by the unit prices bid.

If there are minimum unit prices included in the bid form, those prices shall be the minimum acceptable unit price for the work. If bidder fails to exceed the minimum unit price in his bid, the unit price will be set to the minimum price stated on the bid form, with the appropriate increase to the extension of the unit price and total bid price.

Where no figure is provided by the Bidder in both the "Unit Price" and "Amount" columns for one or more Pay Items, or where no figure is provided in the "Amount" column for one or more lump sum Pay Items the Owner will consider the amount bid to be zero ($0.00) for that item.

Any bid may be submitted or withdrawn prior to the scheduled time for the opening of bids, or authorized postponement thereof. Any bid received after the time and date specified in the Notice to Bidders will not be considered. No bid may be withdrawn within 60 days after the actual date of opening thereof, unless otherwise provided for by law.

2.02 PRICE TO INCLUDE

The bid submitted must cover the entire cost of the contemplated construction and installation as illustrated on the drawings and in the manner and detail described in the specifications. The price bid for each item shall cover the entire cost of its installation, construction, and completion, including all materials, workmanship, and appurtenances necessary for its completion or as implied by illustration on the drawings, by description in the specifications, or to be reasonably inferred therefrom.

2.03 REJECTION OF BIDS

The owner reserves the right to reject all bids, to reject any bid or bids not complying with the specifications, and to waive any informality in any bid or bids if such waiver be deemed by the Owner to

be in the best interests of the Owner in accordance with the requirements contained in N.J.S.A. 40A:11-1 et seq. Each bidder is instructed to be present in person or by representative at the time and place fixed for the opening of bids and at every subsequent meeting of the Owner at which the bidder is advised, or it has been publicly announced at the time of bids, that said bids shall receive further consideration or shall be acted upon, if said bidder desires an opportunity to be heard.

2.04 AWARD OF BID

The award of the contract will be made, subject to necessary monies to do the work being provided by the Owner in accordance with the requirements contained in N.J.A.C. 5:30, Local Finance Board either by Resolution, Ordinance, or in other lawful manner. The contract to be executed by the successful bidder will provide that it shall not become effective until the necessary monies to do the work have been provided by the Owner, either by Resolution, Ordinance or another lawful manner.

In accordance with NJSA 34:11-56.25 et seq., New Jersey State Prevailing Wage Act and NJSA 52:32-44.1 no contract shall be awarded to any contractor, subcontractor, or to any firm, corporation or partnership in which such contractor or subcontractor has an interest, who is debarred from public works or contracting with a federal government agency.

3.0 CONTRACTS

3.01 DRAWINGS AND SPECIFICATIONS FURNISHED

The Engineer shall furnish, at no additional cost to the successful bidder, one executed contract set of drawings and specifications, and two copies of the specifications and drawings. All additional copies of the drawing and/or specifications shall be furnished to the contractor at the cost of reproduction plus handling.

3.02 PERFORMANCE, PAYMENT AND MAINTENANCE BONDS

The bidder whose bid is accepted shall furnish to the Owner, a performance bond and labor and material payment bond, or a combination performance and labor and material payment bond, and upon final completion of the work, a two (2) year maintenance bond, each in the amount of 100% of the final contract price, with such sureties as shall be approved by the Owner and as detailed and described below.

All surety companies must be authorized to transact such business in New Jersey, pursuant to N.J.S.A. 17:17-10 or 17:32-1 et seq. The surety must designate a New Jersey agent on whom service of process can be made. The Contractor shall be responsible for updating the surety's expiration from the list or an agent change, to the Engineer or Owner. All surety companies must have the minimum capital and surplus or net cash assets required, pursuant to N.J.S.A. 17:17-6 or 17:17-7, whichever is applicable, on the date of advertisement for the project. All surety companies must complete a Surety Disclosure Statement and Certification for all payment and performance bonds, pursuant to N.J.S.A. 2A:44-143d.

In addition, for these public works project bids, including any and all alternates, that equals at least $850,000.00 but not more than $3.5 million, the surety company must hold a current certificate of authority issued by the U.S. Secretary of the Treasury that is valid in New Jersey as listed annually in the U. S. Treasury Circular 570. However, if the surety company has been operational for a period in excess of five years, the surety company shall also be considered to have satisfied this requirement if it is rated in one of the three highest categories by an independent nationally recognized United States rating company that determines the financial stability of insurance companies. Such rating companies must meet standards promulgated by the N. J. Commissioner of Insurance N.J.A.C. 11:1-41.1 et seq.

In addition, for those public works project bids, including any and all alternates, is in excess of $3.5 million, the surety company must hold a current certificate of authority issued by the United States

Secretary of the Treasury that is valid in the State of New Jersey listed annually in U.S. Treasury Circular 570. And, if the surety company has been operational for a period in excess of five years, it must be rated in one of the three highest categories by an independent, nationally recognized United States rating company that determines the financial stability of insurance companies. Such ratings must meet standards promulgated in N.J.A.C. 11:1-41.1 et seq.

A surety company, which seeks to provide a payment and performance bond in excess of $3.5 million, is exempt from the requirement of Treasury Circular 570 if it meets standards developed by the Commissioner of Insurance through regulations which, at least equal, and may exceed, the general criteria required for Treasury listing. These standards are found at N.J.A.C. 11:1-41.4.

3.03 LAWS AND REGULATIONS

The bidder's attention is directed to the fact that all applicable Federal, State, County and municipal laws ordinances, regulations, etc. and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the contract throughout, and they will be deemed to be included in the contract the same as though therein written out in full including, but not limited to the "Occupational Safety and Health Act of 1970" P.L. 91-596, as amended.

3.04 PERMITS

The Contractor shall determine which construction permits and licenses shall be needed, and shall procure and pay for all such construction permits and licenses necessary for the execution of his work.

3.05 CONTRACT DOCUMENTS

Attached hereto is the "Form of Contract" that will be executed between the Owner and the Contractor.

The Contractor shall execute and return these documents with the required bonds, insurance certificates, affirmative action forms and any other documents required within ten (10) days after receipt of the request for execution.

3.06 NOTICE TO PROCEED

After approval and execution of the contract documents by all parties and a preconstruction meeting, the contractor shall be sent a "Notice to Proceed." This document serves as formal authorization to proceed with the project.

Any and all work performed by the contractor prior to receipt of the Notice to Proceed is at the contractor's risk with no claim against the Owner for such work.

4.0 AFFIRMATIVE ACTION AGAINST DISCRIMINATION

4.01 BIDDER REFERRED TO LAW

The bidder is specifically referred to N.J.S.A. 10:5-31 et seq., and N.J.A.C. 17:27 as amended and the Regulations adopted pursuant thereto, relating to affirmative action in relation to discrimination.

4.02 SPECIFIC LANGUAGE REQUIRED

In accordance with the Affirmative Action Regulations adopted pursuant to N.J.S.A. 10:5-31 et seq., and N.J.A.C. 17:27, the following is made a part of this Contract:

During the performance of this contract, the contractor agrees as follows:

a. The contractor or subcontractor, where applicable, will not discriminate against any employee or applicant for employment because of age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Except with respect to affectional or sexual orientation and gender identity or expression, the contractor will ensure that equal employment opportunity is afforded to such applicants in recruitment and employment, and that employees are treated during employment, without regard to their age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex. Such equal employment opportunity shall include, but not be limited to the following: employment, up- grading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Public Agency Compliance Officer setting forth provisions of this nondiscrimination clause.

b. The contractor or subcontractor, where applicable will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation, gender identity or expression, disability, nationality or sex.

c. The contractor or subcontractor will send to each labor union, with which it has a collective bargaining agreement, a notice, to be provided by the agency contracting officer, advising the labor union or workers' representative of the contractor's commitments under this act and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

d. The contractor or subcontractor, where applicable, agrees to comply with any regulations promulgated by the Treasurer, pursuant to N.J.S.A. 10:5-31 et seq., as amended and supplemented from time to time and the Americans with Disabilities Act.

e. When hiring or scheduling workers in each construction trade, the contractor or subcontractor agrees to make good faith efforts to employ minority and women workers in each construction trade consistent with the targeted employment goal prescribed by N.J.A.C. l7:27- 7.2; provided, however, that the Dept. of LWD, Construction EEO Monitoring Program may, in its discretion, exempt a contractor or subcontractor from compliance with the good faith procedures prescribed by the following provisions, A, B and C, as long as the Dept. of LWD, Construction EEO Monitoring Program is satisfied that the contractor or subcontractor is employing workers provided by a union which provides evidence, in accordance with standards prescribed by the Dept. of LWD, Construction EEO Monitoring Program, that its percentage of active "card carrying" members who are minority and women workers is equal to or greater than the targeted employment goal established in accordance with N.J.A.C. l7:27- 7.2. The contractor or subcontractor agrees that a good faith effort shall include compliance with the following procedures:

   (A) If the contractor or subcontractor has a referral agreement or arrangement with a union for a construction trade, the contractor or subcontractor shall, within three business days of the contract award, seek assurances from the union that it will cooperate with the contractor or subcontractor as it fulfills its affirmative action obligations under this contract and in accordance with the rules promulgated by the Treasurer pursuant to N.J.S.A. 10:5-31 et seq., as supplemented and amended from time to time and the Americans with Disabilities Act. If the contractor or subcontractor is unable to obtain said assurances from the construction trade union at least five business days prior to the commencement of construction work, the contractor or subcontractor agrees to afford equal employment opportunities minority and women workers directly,

consistent with this chapter. If the contractor's or subcontractor's prior experience with a construction trade union, regardless of whether the union has provided said assurances, indicates a significant possibility that the trade union will not refer sufficient minority and women workers consistent with affording equal employment opportunities as specified in this chapter, the contractor or subcontractor agrees to be prepared to provide such opportunities to minority and women workers directly, consistent with this chapter, by complying with the hiring or scheduling procedures prescribed under (B) below; and the contractor or subcontractor further agrees to take said action immediately if it determines that the union is not referring minority and women workers consistent with the equal employment opportunity goals set forth in this chapter.

(B) If good faith efforts to meet targeted employment goals have not or cannot be met for each construction trade by adhering to the procedures of (A) above, or if the contractor does not have a referral agreement or arrangement with a union for a construction trade, the contractor or subcontractor agrees to take the following actions:

(l) To notify the public agency compliance officer, the Dept. of LWD, Construction EEO Monitoring Program, and minority and women referral organizations listed by the Division pursuant to N.J.A.C. 17:27-5.3, of its workforce needs, and request referral of minority and women workers;

(2) To notify any minority and women workers who have been listed with it as awaiting available vacancies;

(3) Prior to commencement of work, to request that the local construction trade union refer minority and women workers to fill job openings, provided the contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade;

(4) To leave standing requests for additional referral to minority and women workers with the local construction trade union, provided the contractor or subcontractor has a referral agreement or arrangement with a union for the construction trade, the State Training and Employment Service and other approved referral sources in the area;

(5) If it is necessary to lay off some of the workers in a given trade on the construction site, layoffs shall be conducted in compliance with the equal employment opportunity and non-discrimination standards set forth in this regulation, as well as with applicable Federal and State court decisions;

(6) To adhere to the following procedure when minority and women workers apply or are referred to the contractor or subcontractor:

(i) The contactor or subcontractor shall interview the referred minority or women worker.

(ii) If said individuals have never previously received any document or certification signifying a level of qualification lower than that required in order to perform the work of the construction trade, the contractor or subcontractor shall in good faith determine the qualifications of such individuals. The contractor or subcontractor shall hire or schedule those individuals who satisfy appropriate qualification standards in conformity with the equal employment opportunity and non-discrimination principles set forth in this chapter. However, a contractor or subcontractor shall determine that the individual at least possesses the requisite skills, and experience recognized by a union, apprentice program or a referral agency, provided the referral agency is acceptable to the Dept. of LWD, Construction EEO Monitoring Program. If necessary, the contractor or subcontractor shall hire or schedule minority and women

workers who qualify as trainees pursuant to these rules. All of the requirements, however, are limited by the provisions of (C) below.

(iii) The name of any interested women or minority individual shall be maintained on a waiting list, and shall be considered for employment as described in (i) above, whenever vacancies occur. At the request of the Dept. of LWD, Construction EEO Monitoring Program, the contractor or subcontractor shall provide evidence of its good faith efforts to employ women and minorities from the list to fill vacancies.

(iv) If, for any reason, said contractor or subcontractor determines that a minority individual or a woman is not qualified or if the individual qualifies as an advanced trainee or apprentice, the contractor or subcontractor shall inform the individual in writing of the reasons for the determination, maintain a copy of the determination in its files, and send a copy to the public agency compliance officer and to the Dept. of LWD, Construction EEO Monitoring Program.

(7) To keep a complete and accurate record of all requests made for the referral of workers in any trade covered by the contract, on forms made available by the Dept. of LWD, Construction EEO Monitoring Program and submitted promptly to the Dept. of LWD, Construction EEO Monitoring Program upon request.

(C) The contractor or subcontractor agrees that nothing contained in (B) above shall preclude the contractor or subcontractor from complying with the union hiring hall or apprenticeship policies in any applicable collective bargaining agreement or union hiring hall arrangement, and, where required by custom or agreement, it shall send journeymen and trainees to the union for referral, or to the apprenticeship program for admission, pursuant to such agreement or arrangement. However, where the practices of a union or apprenticeship program will result in the exclusion of minorities and women or the failure to refer minorities and women consistent with the targeted county employment goal, the contractor or subcontractor shall consider for employment persons referred pursuant to (B) above without regard to such agreement or arrangement; provided further, however, that the contractor or subcontractor shall not be required to employ women and minority advanced trainees and trainees in numbers which result in the employment of advanced trainees and trainees as a percentage of the total workforce for the construction trade, which percentage significantly exceeds the apprentice to journey worker ratio specified in the applicable collective bargaining agreement, or in the absence of a collective bargaining agreement, exceeds the ratio established by practice in the area for said construction trade. Also, the contractor or subcontractor agrees that, in implementing the procedures of (B) above, it shall, where applicable, employ minority and women workers residing within the geographical jurisdiction of the union.

After notification of award, but prior to signing a construction contract, the contractor shall submit to the public agency compliance officer and the Dept. of LWD, Construction EEO Monitoring Program an initial project workforce report (Form AA 201) electronically provided to the public agency by the Dept. of LWD, Construction EEO Monitoring Program, through its website, for distribution to and completion by the contractor, in accordance with N.J.A.C. 17:27-7. The contractor also agrees to submit a copy of the Monthly Project Workforce Report once a month thereafter for the duration of this contract to the Division and to the public agency compliance officer.

The contractor agrees to cooperate with the public agency in the payment of budgeted funds, as is necessary, for on‐the‐job and/or off‐the‐job programs for outreach and training of minorities and women.

(D) The contractor and its subcontractors shall furnish such reports or other documents to the Dept. of LWD, Construction EEO Monitoring Program as may be requested by the Dept. of LWD, Construction EEO Monitoring Program from time to time in order to carry out the purposes of these regulations, and public agencies shall furnish such information as may be requested by the Dept. of LWD, Construction EEO Monitoring Program for conducting a compliance investigation pursuant to N.J.A.C. 17:27-1.1 et seq.

4.03 CONTRACT PROCEDURES

The Contractor must sign a contract containing the mandatory language in Section 4.02 above entitled "Specific Language Required."

The construction contractors shall complete and submit an Initial Project Workforce Report Form AA-201 upon notification of award. Proper completion and submission of this Report shall constitute evidence of the contractor's compliance with the regulations. Failure to submit this form may result in the contract being terminated. The contractor also agrees to submit a copy of the Monthly Project Workforce Report, Form AA-202 once a month thereafter for the duration of the contract to the Dept. of LWD and to the Public Agency Compliance Officer.

The EEO/AA evidence must be submitted after notification of award, but prior to signing a construction contract. All Public Agencies must retain the affirmative action evidence in their files for review by the Division.

4.04 EQUAL OPPORTUNITY FOR INDIVIDUALS WITH DISABILITIES

The contractor and the Owner do hereby agree that the provisions of Title II of the Americans With Disabilities Act of 1990 (the "Act") (42 U.S.C. S12101 et seq.), which prohibits discrimination on the basis of disability by public entities, in all services, programs and activities provided or made available by public entities, and the rules and regulations promulgated pursuant thereunto, are made part of this contract. In providing any aid, benefit or service on behalf of the Owner pursuant to this contract, the contractor agrees that the performance shall be in strict compliance with the Act. In the event the contractor, its agents, servants, employees, or subcontractors violate or are alleged to have violated the Act during the performance of this contract, the contractor shall defend the Owner in any action or administrative proceeding commenced pursuant to this Act. The contractor shall indemnify, protect, and save harmless the Owner, its agents, servants and employees from and against any and all suits, claims, losses, demands, or damages of whatever kind or nature arising out of or claimed to arise out of the alleged violation. The contractor shall, at its own expense, appear, defend, and pay any and all charges for legal services and any and all costs or other expenses arising from such action or administrative proceeding or incurred in connection therewith. In any and all complaints brought pursuant to the Owner's grievance procedure, the contractor agrees to abide by any decision of the Owner which is rendered pursuant to said grievance procedure. If any action or administrative proceeding results in an award of damages against the Owner, or if the Owner incurs any expense to cure a violation of the Act which has been brought pursuant to its grievance procedure, the contractor shall satisfy and discharge the same at its own expense.

The Owner shall, as soon as practical after a claim has been made against it, give written notice thereof to the contractor along with the full particulars of the claim. If any action or administrative proceeding is brought against the Owner or any of its agents, servants and employees, the Owner shall expeditiously forward or have forwarded to the contractor every demand, complaint, notice, summons, pleading, or other process received by the Owner or its representatives.

It is expressly agreed and understood that any approval by the Owner of the services provided by the contractor pursuant to this contract will not relieve the contractor of the obligation to comply with the Act and to defend, indemnify, protect, and save harmless the Owner pursuant to this paragraph.

It is further agreed and understood that the Owner assumes no obligation to indemnify or save harmless the contractor, its agents, servants, employees and subcontractors for any claim which may arise out of their performance of this contract. Furthermore, the contractor expressly understands and agrees that the provisions of this indemnification clause shall in no way limit the contractor's obligations assumed in this contract, nor shall they be construed to relieve the contractor from any liability, nor preclude the Owner from taking any other actions available to it under any other provisions of this contract or otherwise at law.

PUBLIC WORKS BUILDING

THIS AGREEMENT, between the, the City of Margate City a Municipal corporation of the State of New Jersey, having its principal offices located at 9001 Winchester Avenue, Margate, New Jersey 08402, hereinafter referred to as Owner and (Contractor), having its principal place of business located at (Contractors Address) hereinafter referred to as "Contractor;"

WITNESSETH;

That for and in consideration of the sum of and XX/100 Dollars ($X.XX) contractor agrees to furnish to the Owner, the labor, material, equipment and services in accordance with the contract documents hereinafter set forth.

That for and in consideration of the amount payable under this agreement by the Owner, the Contractor agrees, at its own proper cost and expense, and with due skill and diligence, that it will complete the Public Works Building project in accordance with the contract documents and in compliance with this agreement.

Contractor agrees to receive as full compensation the amount stated herein, namely X.XX, for said services provided to the Owner. Contractor shall be responsible for all loss or damage arising out of the furnishing of the services aforesaid.

To prevent all disputes and litigation, it is agreed by and between the parties to the Contract that the Owner shall in all cases determine the quantity of the goods delivered and paid for under this contract, and as to the interpretation of any ambiguity in or intent of the drawings and specifications.

The Contract documents shall consist of the following:

1. Notice to Bidders.
2. Specifications.
3. Contractors Proposal (as accepted).
4. Contract Agreement.
5. Contract Drawings
6. All Addenda.

The parties to this contract agree to incorporate into this contract the mandatory language of the Regulations promulgated by the Treasurer pursuant to N.J.S.A. 10:5-31 et seq. and N.J.A.C. 17:27, as amended and supplemented from time to time and the contractor or subcontractor agrees to comply fully with the terms, provisions, and obligations of said Regulations.

AND in all respects comply with all requirements of the Labor Laws of the State of New Jersey, applicable to contracts on behalf of the Municipal Government for construction, alteration, or repair of any building or public work, including particularly, be without limitation of the foregoing, the provision that not less than the prevailing rate of daily wages in the locality where the work is performed shall be paid to mechanics, workmen and laborers employed by the contractors or subcontractors or by or in behalf of the State or any county or municipality;

The contract partner shall maintain all documentation related to products, transactions or services under this contract for a period of five years from the date of final payment. Such records shall be made available to the New Jersey Office of the State Comptroller upon request.

Payment shall be made to said Contractor by orders upon the Treasurer of said City of Margate City, founded upon estimates of the City Commissioners as to the amount of work done or articles furnished and delivered, or both, and upon presentation by said Contractor, to the City of Margate City Treasurer of said City of Margate City an appropriate voucher setting forth, in writing, the amount of work done or goods furnished, and that the work done or articles furnished are according to this Contract, and according to law;

AND it is distinctly and mutually understood and agreed by and between the parties hereto, that in case a default is made in the completion of the Contract, in accordance with the terms and conditions hereof, such money as may be due to said Contractor, or such as would have become due had the terms and conditions of this Contract and agreement been complied with, shall be and is hereby forfeited to said City of Margate City, and said City of Margate City is free to use the same in and about the completion of said contract, and in case said City of Margate City is put to any costs and expenses over and above the contract price of the Contractor, in and about the completion of the Contract, said Contractor for themselves, itself, their heirs, executors, administrators, successors and assigns, expressly agree to hold themselves, itself, their

heirs, executors, administrators, successors and assigns, liable therefore, and hereby covenant and agree to make good the same to the City of Margate City. Upon the City of Margate City's determination that services provided by the contractor are unsatisfactory, said contract may be cancelled subject to thirty (30) days written notice being provided to the contractor;

The Contractor agrees to make payments of all proper charges for labor and materials required in the aforementioned work, and defend, indemnify and save harmless the City of Margate City, its officers, agents and servants and each and every one of them against and from all suits and costs of every name and description, including attorney's fees and costs and from all damages to which said City of Margate City or any of its officers, agents or servants may be put by reason of injury to the person or property of others resulting from carelessness in the performance of said work, or through the negligence of the Contractor, or through any improper or defective machinery, implements or appliances used by said Contractor in the aforesaid work or through any act or omission on the part of said Contractor, or his agent or agents. This provision applies regardless of whether insurance coverage is provided. It is also agreed and understood that the acceptance of the final payment by the Contractor shall be considered as a release in full of all claims against the City of Margate City out of, or by reason of, the work done and materials furnished under this contract; and

AND it is expressly understood and agreed that this Contract and the referenced inclusion of the bid documents represent the full understanding between the parties and any representations, whether oral or in writing, not contained herein, will not be binding on the parties hereto.

This agreement, together with the contract documents, forms the contract and they are as fully a part of this contract as if hereto attached or herein repeated.

The Owner and the Contractor, for themselves, their heirs, executors, administrators, successors or assigns, hereby agree to the full performance of the covenants herein contained.

IN WITNESS WHEREOF, they have executed this Agreement.

CONTRACTOR: ATTEST:

_____ BY_____

_____ _____

Print Name & Title **Print Name & Title (Seal)**

OWNER: City of Margate City ATTEST:

_____ BY_____

Michael Collins, Mayor **Johanna Casey, R.M.C. (Seal)**

CERTIFICATE OF INSURANCE

Name & Address of Insured

					Limits of Liability		
Afforded	Required (Enter (X))	Type of Insurance	Policy Number and Insuring Company(ies)	Policy Expiration Date	Amounts of Less Than $1,000,000 Will Not Be Acceptable	Amount Required Each Occurrence	Amount Provided Each Occurrence
☐	☒	General Liability Comprehensive Gen. Form			General Aggregate	$2,000,000	$
☐	☒	Premises-Operations			Bodily Injury	$1,000,000	$
☐	☒	Explosion & Collapse Hazard					
☐	☒	Underground Hazard			Property Damage	$1,000,000	
☐	☒	Products/Completed Operations Hazard					
☐	☒	Contractual Ins. (Blanket)			Bodily Injury and Property Damage Combined	$1,000,000	$
☐	☒	Broad Form Prop. Damage					
☐	☒	Independent Contractors					
☐	☒	Personal Injury			Personal Injury	$1,000,000	$
		Automobile Liability			Bodily Injury (Each Person)	$1,000,000	$
☐	☒	Comprehensive Form			Bodily Injury (Each Accident)	$1,000,000	$
☐	☒	Owned					
☐	☒	Non-Owned			Property Damage	$1,000,000	$
☐	☐	Garagekeepers Insurance (Without regard to legal liability as direct coverage on a primary basis)			Bodily Injury and Property Damage Combined	$1,000,000	
		Excess Liability			Bodily Injury and	$1,000,000	$
☐	☒	Umbrella Form			Property Damage Combined		
☐	☐	Other Than Umbrella Form					
☐	☒	Worker's Compensation and Employers' Liability	*All States Endorsement		Statutory NJ Coverage $100,000/$500,000		
					Minimum $100,000	$100,000	$

Remarks: Additional Insured: **REMINGTON & VERNICK ENGINEERS, MARGATE CITY and MARGATE CITY SOLICITOR**

It is understood and agreed that in the event of any material change in, cancellation of, or expiration of the above policy or policies the undersigned Insurance Company agrees to given a written notice to the Owner, at the above address thirty (30) days in advance of such change or cancellation.

This certificate is executed and issued to the Owner on the day and date herein below written certifying that the Insured has been issued the above policy or policies with Limits of Liability of at least the required amounts.

*** PLEASE PUT "X'S" IN AFFORDED COLUMN OR CERTIFICATE WILL BE RETURNED ***

Name of Agency

Street Address

City, State & Zip Code

Signature of Authorized Representative of Insurance Company

Address Date

Agency Telephone No.

TO: INSURANCE PRODUCER

Your client, as a supplier to the Owner is required to provide a certificate of insurance for the coverages and amounts indicated on the reverse side of this insurance certificate. It is important to your client that you respond quickly since continued business relationships depend upon valid insurance. Additionally, the minimum amount and type of coverage shown on our certificate is not negotiable and is not intended to imply that is all the insurance necessary to protect him/her from all losses or liability. It is the Owner's policy to require all suppliers who make deliveries or perform assembly, repair operations or a service in, on or upon our property/premises or property/premises under our care, custody and control to maintain the insurance coverage described below; such insurance must be obtained prior to the start of any such work the Owner.

A. Comprehensive General Liability (CGL)

This coverage must include: Premises-Operations, Products/Completed Operations Hazard, Contractual Insurance (Blanket Coverage), Broad Form Property Damage, Independent Contractors, and Personal Injury and all others shown on "X" in the required column.

Minimum Coverage

Bodily Injury and Property Damage combined - as shown in the amount required column

AMOUNTS OF LESS THAN $1,000,000 WILL NOT BE ACCEPTABLE.

Contractual Insurance (Blanket Coverage)

Contractual Indemnification - Save Harmless Agreement which is incorporated into all Vouchers, General Purchase Agreements and Contracts.)

INDEMNIFICATION

Supplier shall defend, indemnify and save harmless, the Owner from and against all losses, costs, damages, expense claims or demands arising out of or caused or alleged to have been caused in any manner by a defect in any equipment or materials supplied hereunder or by doing the work herein provided, including all suits or actions of every kind of description brought against Owner, either individually or jointly with Supplier for or on account of any damage or injury to any person or persons or property, caused or occasioned or alleged to have been caused by or on account of the performance of any work pursuant to or in connection with this contract or through any negligence or alleged negligence in guarding the work or through any act, omission or fault or alleged act, omission or fault of the Supplier, its employees or agents, or others under Supplier's control.

B. Automobile Liability - Comprehensive Form (or as shown on reverse side)

Minimum Coverage

Bodily Injury and Property Damage combined - as shown in the amount required column.

C. Worker's Compensation - As required by New Jersey State Statute

and

Employer's Liability (minimum $100,000)

D. Excess Liability

Commercial Umbrella Form - $1,000,000.

E. Other Coverage(s)

As shown on reverse side.

THANK YOU

Important - Producer:

PLEASE CHECK THE AFFORDED BLOCK FOR EACH COVERAGE PROVIDED.

THE CERTIFICATE MUST BE SIGNED BY THE AGENT OF THE INSURER OR CERTIFICATE WILL BE RETURNED.

IT IS NECESSARY TO SUBMIT YOUR CLIENTS COVERAGE THIRTY (30) DAYS PRIOR TO THE EXPIRATION OF THE EXISTING COVERAGE ON OUR CERTIFICATE ONLY; ALL OTHERS WILL BE RETURNED TO THE SUPPLIER AND SERVE TO DELAY FUTURE BUSINESS DEALINGS BETWEEN THE OWNER AND YOUR CLIENT.

TABLE OF CONTENTS
SUPPLEMENTAL GENERAL CONDITIONS

PAGE NO.

2.0 INSURANCE

2.05 Atlantic County Municipal Joint Insurance Fund SUPPLEMENTAL GC-1

SUPPLEMENTAL GENERAL CONDITIONS

2.0 INSURANCE

2.05 ATLANTIC COUNTY MUNICIPAL JOINT INSURANCE FUND REQUIREMENTS

The Owner, being a member of the Atlantic County Municipal Joint Insurance Fund, has established the following additional requirements for insurance. The Contractor shall meet or exceed all insurance requirements contained in this contract document, including but limited to these Supplemental General Conditions. If and where any requirements are conflicting, the more stringent requirement shall prevail.

(a) Indemnification:

Contractor/Vendor shall defend, indemnify, save harmless the Municipality, its elected and appointed officials, its employees, agents, volunteers and others working on behalf of the Municipality, from and against any and all liability, suits, damages, costs (including attorney's fees), losses, outlays, and expenses from claims in any manner caused by or allegedly caused by, or arising out of, or connected with, this Contract, or the work of any subcontract thereunder (the Contractor/Vendor hereby assuming full responsibility for relations with subcontractors), including but not limited to claims for personal injuries, death, property damage, and/or for damages from the award of this Contract to the Contractor/Vendor, notwithstanding any possible negligence, whether sole or concurrent, on the part of the Municipality, its officials or agents.

Contractor/Vendor shall indemnify and hold the Municipality harmless from all wages or overtime compensation due any employees in rendering services pursuant to this agreement or any subcontract, including payment of reasonable attorney's fees and costs in the defense of any claim made under the Fair Labor Standards Act, the New Jersey Prevailing Wage Law or any other federal or state law. Nothing herein shall preclude the Municipality from requiring additional documentation as needed to ensure that the appropriate wage rates are being paid in order to ensure compliance with all state and federal rules, regulations and statutes.

The indemnification obligations of the Contractor/Vendor hereunder shall not be limited by any limitations as to the amount or type of damages, compensation or benefits payable by or for the Contractor/Vendor, under any federal or state law, to any person asserting the claim against the Municipality, its elected or appointed officials, agents and employees, for which indemnification is sought.

The indemnification obligations herein shall not negate, abridge or reduce in any way any additional indemnification rights of the Municipality, its elected or appointed officials, agents and employees, which are otherwise available under statute, or in law or equity.
Contractor/Vendor affirms that it has had the opportunity to recover the costs of liability insurance required in this agreement in its contract price. Contractor/Vendor's obligation under this agreement to defend, indemnify and hold harmless any person from that person's own negligence or wrongdoing is limited to the coverage and limits of the applicable insurance required of the Contractor/Vendor under this agreement.

The Contractor/Vendor shall indemnify and hold the Municipality harmless for any penalties, fines, fees or costs, including costs of defense, which are charged or assessed by any Federal, State or local agency including, but not limited to, the Environmental Protection Agency or Department of Natural Resources and the New Jersey Department of Environmental Protection.

The Contractor/Vendor shall hold and save the Municipality, its elected or appointed officials, agents, servants and employees harmless for liability of any nature or kind, including costs and expenses for, or on account of any patented or unpatented invention, process, article, or appliance manufactures or used in the performance of the Contract including its use by the Municipality, unless otherwise specifically stipulated in the Contract document.

If the Contractor/Vendor uses any design device, materials covered by letters, patent or copyright, any proprietary computer hardware, software/software applications or telecommunications systems or equipment, the Contractor/Vendor shall provide for such use by suitable agreement with the owner of

such patented or copy-righted design device or material or any proprietary computer hardware, software/software applications or telecommunications systems or equipment. It is mutually agreed and understood that without exception, the contract prices shall include all royalties or costs arising from the use of such design, device, applications or materials, in any way involved in the work.

The Contractor/Vendor and/or his Sureties shall indemnify and save harmless the Municipality/Owner of the project from any and all claims for infringement by reason of the use of such patented or copy-righted design, device or materials, any proprietary computer hardware, software/software applications or telecommunications systems or equipment and any trademark or copyright in connection with work agreed to be performed under this Contract, and shall indemnify the Municipality/Owner for any cost, expense, or damage which it may be obligated to pay by reason of such infringement at any time during the performance of the work or after completion of the work.

(b) Insurance:

Without limiting any of the other obligations or liabilities of the Contractor/Vendor, the Contractor/Vendor shall secure and maintain, at its own cost and expense, throughout the duration of this Contract and until the work is completed and accepted by the Municipality, insurance of such types and in such amounts as may be necessary to protect it and the interests of the Municipality against all hazards or risks of loss as hereunder specified or which may arise out of the performance of the Contract Documents. The form and limits of such insurance, together with the underwriter thereto in each case, are subject to approval by the Municipality. Regardless of such approval, it shall be the responsibility of the Contractor/Vendor to maintain adequate insurance coverage at all times during the term of the Contract. Failure of the Contractor/Vendor to maintain coverage shall not relieve it of any contractual responsibility or obligation or liability in general or under the Contract Documents.

Contractor/Vendor shall be required to name the Municipality, Municipal Solicitor and Remington & Vernick Engineers as an "Additional Insured" in the Contractor/Vendor's policy of commercial general liability insurance through an Endorsement to the policy, and simultaneously with the delivery of the executed Contract Documents, Contractor/Vendor shall provide the Municipality with a Certificate of Insurance and Endorsement indicating that the insurance coverage as described in the attached schedule, and as is appropriate for the work being performed and furnished, has been obtained and that the Municipality, Municipal Solicitor and Remington & Vernick Engineers has been designated as an "Additional Insured" where required. On or before the renewal date of said policy, Contractor/Vendor shall be required to provide the Municipality with a Certificate of Insurance and Endorsement indicating the continuation of insurance coverage and designating the Municipality, Municipal Solicitor and Remington & Vernick Engineers as an "Additional Insured".

The Engineer and Municipal Solicitor shall be named in the policy as an additional insured with first part coverage as opposed to just vicarious liability coverage. This requirement shall not and does not substitute for the indemnification requirement, but shall be in addition hereto.

The Schedule of Insurance and the Limits of Liability for the insurance shall provide coverage for not less than the following amounts (or greater) where required by law:

(c) Schedule of Insurance:

The schedule of insurance and the limits of liability for the insurance shall provide coverage for not less than the amounts contained in this section, or greater where required by law.

Notwithstanding the indemnification and defense obligations of the Contractor, the Contractor shall provide at its own cost and expense proof of the following insurance to the City:

1. <u>Workers' Compensation</u>

Worker's Compensation coverage as required by New Jersey State law with a Certificate of Insurance indicating "statutory limits.

Employer's Liability with limits not less than $1,000,000 per accident for bodily injury or disease.

30-day notice of intent to cancel, non-renew, or make material change in coverage.

2. Commercial General Liability

Commercial General Liability with a $5,000,000 Limit of Liability per occurrence and aggregate for Bodily Injury, Personal and Advertising Injury and Property Damage including Blanket Contractual Liability, Products Liability, Complete Operations and all Broad Form Comprehensive General Liability enhancements.

The $5,000,000 limit may be satisfied with an Umbrella or Excess Liability Policy over the Commercial General Liability policy.

Contractor's insurance to be primary and non-contributory.

30-day notice of intent to cancel, non-renew, or make material change in coverage.

Waiver of subrogation

Municipality, Municipal Solicitor and Municipal Engineer shall be named as "Additional Insured".

3. Automobile Liability Insurance

$1,000,000 Combined Single Limit of Liability for Bodily Injury and Property Damage per accident
Contractor's insurance to be primary and non-contributory.

30-day notice of intent to cancel, non-renew, or make material change in coverage.

Waiver of subrogation

Municipality, Municipal Solicitor and Municipal Engineer shall be named as "Additional Insured".

4. Errors and Omissions/Professional Liability (If Contractor performs engineering and/or architectural services)

$1,000,000 per claim Professional Liability/Errors and Omissions coverage.

30-day notice of intent to cancel, non-renew or make material change in coverage

5. Builders Risk Insurance – Contractor shall provide a Builder's Risk Policy to be payable to the Municipality in an amount equal to the replacement cost of the building. Such insurance shall be provided on an All Risk basis and include coverage, without limitation, for windstorm, storm surge, flood and earth movement. Unless waived by the Municipality by Resolution, it shall include coverage for ordinance and law, demolition and increased costs of construction, debris removal, pollutant clean up and removal, and expediting costs. Such insurance shall cover, without limitation, (a) all buildings and/or structures involved in the work, as well as temporary structures at the Site, and (b) any property that is intended to become a permanent part of such building or structure, whether such property is on Site, in transit or ion temporary storage. The policies shall name the Contractor as the named insured and list the Municipality as both an additional insured, through an Endorsement to the policy, and Loss Payee as its interest may appear.

30-day notice of intent to cancel, non-renew, or make material change in coverage.

Waiver of subrogation

Municipality, Municipal Solicitor and Municipal Engineer shall be named as "Additional Insured".

6. Pollution Risk Insurance – Pollution Liability Insurance covering Contractor/Vendor's or appropriate subcontractor's liability for bodily injury, property damage and environmental damage resulting from sudden accidental and gradual pollution and related cleanup costs incurred by Contractor/Vendor, all arising out of the Goods delivered or Services (including transportation risk) performed under this Contract is required. Combined single limit per occurrence shall not be less than One Million $1,000,000.00) Dollars. Annual aggregate limit shall not be less than Three Million ($3,000,000.00).

   30-day notice of intent to cancel, non-renew, or make material change in coverage.

   Waiver of subrogation

   Municipality, Municipal Solicitor and Municipal Engineer shall be named as "Additional Insured".

7. Owner's and Contractor's Protective Liability. Insurance to protect the Municipality, its agents, servants and employees from claims which may arise from the performance of this Contract, with limits of at least One Million ($1,000,000.0) Dollars for all claims arising out of a single accident or occurrence and at least Three Million ($3,000,000.00) dollars with respect to injuries and/or death of any one person in a single accident.

   The Owner's and Contractor's Protective Liability Insurance must:
   a. Be a separate policy with the named insured being: The Municipality and
   b. Contain an endorsement that disclaims coverage for any claim barred by the doctrines of sovereign immunity or official immunity, except attorney's fees and other litigation costs incurred in defending a claim. Nothing contained in this policy (or this endorsement thereto) shall constitute a waiver of whatever kind of these defenses or sovereign immunity or official immunity for any monetary amount whatsoever.

   30-day notice of intent to cancel, non-renew, or make material change in coverage.

   Waiver of subrogation

   Municipal Solicitor and Municipal Engineer shall be named as "Additional Insured".

Failure by the Contractor to supply such written evidence of required insurance and to maintain same for the duration of this contract shall result in default under this contract.

The insurance companies for the above coverages must be licensed by the State of New Jersey with a current A.M. Best's rating of no less than A-VII and acceptable to the City. The Contractor shall take no action to cancel or materially change any of the insurance required under this Contract without the City's prior approval. The maintenance of insurance under this section shall not relieve the Contractor of any liability greater than the limits or scope of the applicable insurance coverage.

DEDUCTIBLES AND SELF-INSURED RETENTIONS

Any deductibles or self-insured retentions must be declared to and approved by the Municipality. At the option of the Municipality, either: the insurer shall reduce or eliminate such deductibles or self- insured retentions as respects the Municipality, its officers, officials, employees and volunteers; or the Contractor shall provide a financial guarantee satisfactory to the Municipality guaranteeing payment of losses and related investigations, claim administration and defense expenses.

OTHER INSURANCE PROVISIONS

The General Liability and Automobile Liability policies are to contain, or be endorsed to contain, the following provisions:

1. To the fullest extent permitted by law, the Municipality, its officers, officials, employees, and volunteers are to be covered as insureds with respect to liability arising out of automobiles owned, leased, hired or borrowed by or on behalf of the contractor; and with respect to liability arising out of work or operations performed by or on behalf of the Contractor including materials, parts or equipment furnished in connection with such work or operations. General Liability coverage can be provided in the form of an endorsement to the Contractor's insurance, or as a separate owner's policy.

2. For any claims related to this project, the Contractor's insurance coverage shall be primary insurance as respects the Municipality, its officers, officials, employees, and volunteers. Any insurance or self-insurance maintained by the, its officers, officials, employees, or volunteers shall be excess of the Contractor's insurance and shall not contribute with it.

3. Coverage required under this Agreement shall not be canceled or non-renewed without 30 days prior written notice from contractor to the Municipality, except where cancellation is for non-payment of premium, then 10 days' prior notice shall be given.

4. Any insurance proceeds available to the contractor that are broader than or in excess of the specified minimum insurance coverage and/or limits shall be available to the Municipality as an additional insured. Furthermore, the requirements for coverage and limits shall be (1) the minimum limits specified in the contract/agreement, or (2) the broader coverage and maximum limits of coverage of any insurance policy or proceeds available to the Named Insured, whichever is greater.

5. If General Liability, and/or Professional Liability coverages are written on a claims-made form:
   a. The retroactive date must be shown, and must be before the date of the contract or the beginning of contract work.
   b. Insurance must be maintained and evidence of insurance must be provided for at least five (5) years after completion of contract work.
   c. If coverage is canceled or non-renewed, and not replaced with another claims-made policy form with a retroactive date prior to the contract effective date, the Contractor must purchase an extended period coverage for a minimum of five (5) years after completion of contract work.
   d. A copy of the claims reporting requirements must be submitted to the Municipality for review.

VERIFICATION OF COVERAGE

Contractor shall furnish the Municipality with original certificates and amendatory endorsements effecting coverage required by this clause. All certificates and endorsements are to be received and approved by the Municipality before work commences. However, failure to do so shall not operate as a waiver of these insurance requirements. The Municipality reserves the right to require complete, certified copies of all required insurance policies, including endorsements affecting the coverage required by these specifications at any time.

WAIVER OF SUBROGATION

Contractor hereby grants to the Municipality a waiver of any right to subrogation which any insurer or contractor may acquire from contractor by virtue of the payment of any loss. Contractor agrees to obtain any endorsement that may be necessary to affect this waiver of subrogation.

The Workers' Compensation policy shall be endorsed with a waiver of subrogation in favor of the Municipality for all work performed by the contractor, its employees, agents and subcontractors.

SUBCONTRACTORS

Contractor shall require and verify that all subcontractors maintain insurance meeting all the requirements stated herein.

TABLE OF CONTENTS
GENERAL CONDITIONS

			PAGE NO.
1.0	GENERAL PROVISIONS		
	1.01	Definitions	GC-1
	1.02	Special Notice	GC-2
	1.03	Representation of Contractor	GC-2
	1.04	Subletting or Assigning of Contract	GC-2
	1.05	Construing the Specifications	GC-2
	1.06	Necessary to Complete	GC-2
	1.07	Drawings and Specifications	GC-2
	1.08	Right-Of-Way	GC-3
	1.09	Time Limits	GC-3
	1.10	Liquidated Damages	GC-3
	1.11	Owner's Right to Stop Work or Terminate Contract	GC-4
	1.12	Reference to the Standard Specifications	GC-5
2.0	INSURANCE		
	2.01	State Law and Regulations and Insurance	GC-5
	2.02	Contractor's Insurance	GC-5
	2.03	Suit or Claims	GC-6
	2.04	Damages to Persons and Property	GC-6
3.0	CONDUCT OF THE WORK		
	3.01	Role of the Engineer	GC-6
	3.02	Surveys	GC-6
	3.03	Preservation of Stakes	GC-7
	3.04	Uses of Premises and Removal of Debris	GC-7
	3.05	Injury to Existing Structures	GC-7
	3.06	Correction of Work	GC-7
	3.07	Public Utilities	GC-8
	3.08	Protection of Work and Property	GC-8
	3.09	Contractor to Act in an Emergency	GC-8

			PAGE NO.
	3.10	Extra Work	GC-8
	3.11	Dispute Resolution	GC-9
4.0	CONTRACTOR'S PERSONNEL		
	4.01	Personal Attention	GC-9
	4.02	Contractor's Superintendent	GC-9
	4.03	Labor Laws	GC-10
	4.04	Contractor's Employees	GC-10
	4.05	Eight Hour Day: Prevailing Wage Rate	GC-11
	4.06	Payment of Employees	GC-11
	4.07	Safety and Health Regulations	GC-11
	4.08	Accident Prevention	GC-11
5.0	MATERIALS		
	5.01	Contractor's Title to Materials	GC-11
	5.02	Royalties and Payments	GC-11
	5.03	Use of Domestic Material	GC-11
	5.04	Ordering Materials	GC-12
	5.05	Samples	GC-12
	5.06	Shop or Setting Drawings	GC-12
	5.07	Additional Instructions and Detail Drawings	GC-12
	5.08	Or Equal Clauses	GC-13
	5.09	Substitutions	GC-13
	5.10	Material Safety Data	GC-13
6.0	INSPECTION AND TESTING		
	6.01	Inspection	GC-14
	6.02	Daily Reports	GC-14
	6.03	Inspectors	GC-14
	6.04	Access to the Work	GC-15
	6.05	Covering Uninspected Work	GC-15
	6.06	Testing Materials	GC-15

PAGE NO.

7.0 PAYMENTS

7.01	Construction Schedule and Periodic Estimates	GC-15
7.02	Payments	GC-16
7.03	Retainage	GC-17
7.04	Acceptance of Final Payment as Release	GC-17
7.05	Owner's Right to Withhold Payments	GC-18
7.06	Costs of Engineering and Inspection	GC-18
7.07	Liens	GC-18
7.08	Prevailing Wage Payment Certificate	GC-18
7.09	Certified Payroll Reports	GC-18

8.0 VALUE ENGINEERING CONSTRUCTION CHANGE ORDERS

8.01	Implementation of Value Engineering	GC-19
8.02	Statutory Provisions	GC-19
8.03	Procedures	GC-20

9.0	DIFFERING SITE CONDITIONS PROVISIONS	GC-23
	Prevailing Wage Payment Certification Form	GC-26
	Form GC-6.02S - Certificate of Site Safety Conditions	GC-27
	Full Release and Waiver of Liens	GC-28

GENERAL CONDITIONS

1.0 GENERAL

1.01 DEFINITIONS

The following words and expressions used in the contract documents shall be construed as follows:

Owner.....City of Margate City
9001 Winchester Avenue
Margate, New Jersey 08402

Engineer . .....Remington & Vernick Engineers
2819 Fire Road, 1st Floor
Egg Harbor Township, NJ 08234

Contractor.....Party, firm, corporation with whom or which the contract is made, or authorized agent thereof.

Day .....Calendar day.

Legal Holiday.....Days which the owner does not conduct regular business hours. The Contractor is responsible to contact the Owner for a listing of these days.

Substantial Completion ……. The work will not reach Substantial Completion until all project systems included in the work are operational as designed and scheduled, all designated or required inspections, certifications, permits, approvals, licenses and other documents from any governmental authority having jurisdiction thereof necessary for the beneficial use and occupancy of the work are received, designated instruction of Owner's personnel has been completed, and all final finishes within the Contract are in place. Any remaining work shall be minor in nature, so that the Owner can occupy the building on that date and the completion of the remaining work by the Contractor would not materially interfere or hamper the Owner's (or those claiming by, through or under the Owner) normal operations. Contractor recognizes that normal operations require the use and occupancy of the work area without interruption and that any punchlist or corrective work shall be done at times when the work area is not so occupied. As a further condition of reaching Substantial Completion, the Contractor shall certify that all remaining work will be completed within thirty (30) consecutive calendar days or as so agreed upon following the date of Substantial Completion. Site related projects and/or projects including facilities with site improvements shall not reach Substantial Completion until such time as all site amenities (i.e. lighting, top paving, striping, fencing, stormwater compliance, etc..) are placed into service leaving only minor improvements that will not hamper access or use to complete the project."

Final Completion ……...All warranties and guarantees required pursuant to the Contract Documents shall be assembled and delivered by the Contractor to the Owner as part of the final application for payment. The final Certificate for Payment will not be issued by the Engineer until all warranties and guarantees have been received and accepted by the Owner.

1.02 SPECIAL NOTICE

The "Information for Bidders", the "General Conditions", the "Notice to Bidders", and "Proposal Section" shall be held equally binding with and are to be considered a part of the specifications and contract and the party of the second part, the Contractor, will be held responsible for neglect in attending to any part, paragraph or item therein.

1.03 REPRESENTATION OF CONTRACTOR

The Contractor represents and warrants:

(a) That he is financially solvent and that he is experienced in and competent to perform the type of work to furnish the labor, plant, materials and supplies or equipment to be so performed or furnished by him and

(b) That he is familiar with all Federal, State, County, Municipal and Department Laws, Ordinances and Regulations, which may in any way affect the work or those employed therein, including, but not limited to, any special Acts relating to the work or to the project of which it is a part, and

(c) That such temporary and permanent work required by the contract documents and is to be done by him can be satisfactorily constructed and used for the purpose for which it is intended, and that such construction will not injure any persons or damage any property, and

(d) That he has carefully examined the drawings, specifications, and the site of the work, and that from his own investigations he has satisfied himself as to the nature and location of the work, the character, quality and quantity of surface and subsurface materials likely to be encountered, the character of equipment and other facilities needed for the performance of the work, the general and local conditions and all other items which may in any way affect the work or its performance.

1.04 SUBLETTING OR ASSIGNING OF CONTRACT

The Contractor shall not assign, sell or transfer or otherwise dispose of the contract or any portion thereof or of the work provided therein or his right, title or interest therein, to any persons, firm or corporation, without prior written consent of the Owner.

1.05 CONSTRUING THE SPECIFICATIONS

To avoid disputes and litigation, it must be distinctly understood by the Bidder/Contractor that the Engineer shall construe or interpret the specifications and explain any ambiguity therein and shall have the right to decide as to their purpose and intent and his decision upon any such ambiguity shall be final, conclusive and binding.

1.06 NECESSARY TO COMPLETE

If any work or materials are required which are obviously necessary to carry out the full intent and meaning of the said specifications although the same may not be either directly or indirectly in the specifications, the Contractor is hereby bound to furnish the same without charge or claim.

1.07 DRAWINGS AND SPECIFICATIONS

The Contractor shall keep at the site of the work one copy of the drawings and specifications signed and identified by the Engineer and shall at all times give the Engineer and other representatives of the Owner access thereto. Anything shown on the drawings and not mentioned in the specifications, or mentioned in the

specifications and not shown on the drawings, shall have the same affect as if shown or mentioned respectively in both. In case of any conflict within the construction documents, the Engineer shall determine which of the requirements shall govern based upon the most stringent of the requirements, and the Contractor shall perform the work at no additional cost or time to the owner. Any ambiguity or discrepancy between drawings and specifications shall be submitted by the Contractor to the Engineer whose decision shall be conclusive.

The general arrangement and location of equipment, the various pipe, duct, and conduit runs, etc. are shown on the drawings. All dimensions or the scales of the drawings shall be considered as approximate and shall be checked by each bidder to his own satisfaction prior to bid. The exact location of all parts of the work shall be governed by existing conditions, and the Contractor shall coordinate and locate all work at the time of installation. Any changes in location, etc. from that shown on the drawings, necessary by existing conditions, shall be made by the Contractor at no increase of the contract sum.

1.08 RIGHT-OF-WAY

All right-of-ways through private property required shall be secured by the Owner. Contractor shall not start construction in right-of-ways until directed by the Engineer. No claim shall be made by the Contractor for damage due to delay in securing right-of-ways.

1.09 TIME LIMITS

The Contractor agrees to start the work herein contracted for within ten (10) days from the date of the Engineer's Notice To Proceed to the Contractor directing him to proceed with the work. The time to complete the work contracted for, from the date of the Proceed Order, shall be limited to the following:

330 Calendar Days

No extension of time will be allowed for delay from any cause whatsoever, including normal weather conditions unless the Contractor shall have notified the Engineer in writing of such delay and his intention to claim an extension of time within two (2) days after the beginning of such delay. Such notice shall give complete information concerning the nature, extent and cause of the delay. If, in the opinion of the Owner, an extension of time is warranted the Owner or Owner's representative, will issue a written extension, setting a new time limit for the completion of the work. Additionally, should the Owner grant the Contractor an extension of Contract time, the Contractor shall not be due any compensation for the extended contract time unless specifically indicated in writing at the time of the extension. Failure of Owner or Owner's Representative to expressly respond to a reservation of rights letter from Contractor reserving a right to additional compensation shall in no way be deemed an admission that Contractor is entitled to additional fees. Any costs associated with increased contract time due to approved change order work must be specifically identified included in the change order at the time of submission.

1.10 LIQUIDATED DAMAGES

In case the Contractor fails to complete the work contracted for, satisfactory to and acceptable to the Owner within the stipulated time limit, or violates any terms or conditions of said contract or the terms and conditions of N.J.S.A. 40A:11-1 et seq. (Local Public Contracts Law), then the Contractor shall and will pay to the Owner for each and every calendar day determined to be in default, the following sums, which are agreed upon, fixed and determined by the parties hereto to be liquidated damages. Liquidated damages shall not be assessed beyond substantial completion.

One (1) to Fifteen (15) Days beyond Contract Time Limits
Five Hundred ($500.00) dollars per calendar day.
Sixteen (16) to Thirty (30) Days beyond Contract Time Limits

One Thousand ($1,000.00) dollars per calendar day.
Greater than Thirty (30) Days beyond Contract Time Limits
Two Thousand ($2,000.00) dollars per calendar day

The Owner shall recover said damages by deducting the amount thereof out of any money which may be due or become due the Contractor, or by an action of law against the Contractor, his surety or by either or both of these methods.

In case the Contractor shall be delayed due to the failure on the part of the Owner to furnish anything on its part to be furnished or for any other cause beyond the control of the Contractor, he shall be entitled to such an extension of time for the delivery of equipment, materials, work and supplies as in the judgement of the Owner or Owner's representative to be fair and just.

1.11 OWNER'S RIGHT TO STOP WORK OR TERMINATE CONTRACT

The Owner has the right to stop work or terminate the contract, if:

(a) The Contractor has violated the provisions of N.J.S.A. 40A:11-1 et seq. (Local Public Contracts Law), or any other Federal, State or Local law, or

(b) The Contractor shall be adjudged bankrupt or make an assignment for the benefit of creditors, or

(c) A receiver or liquidator shall be appointed for the Contractor or for any of his property and shall not be dismissed within 20 days after such appointment or the proceedings in connection therewith shall not be stayed on appeal within the said 20 days, or

(d) The Contractor shall refuse or fail, after notice or warning from the Engineer, to supply enough properly skilled workmen or proper materials, or

(e) The Contractor shall refuse or fail to prosecute to work or any part thereof with such diligence as will ensure its completion within the period herein specified (or any duly authorized extension thereof) or shall fail to complete the work within said period, or

(f) The Contractor shall fail to make prompt payment to persons supplying labor or materials for the work, or

(g) The Contractor shall fail or refuse to regard laws, ordinances or regulations or otherwise to be guilty of a violation of any provisions of the contract or the Scope of Work therein, then and in such event, the Owner, without prejudice or any rights or remedy it may have, may give seven (7) days notice to the Contractor to terminate the employment of the Contractor and his right to proceed, either as to the entire work or at the option of the Owner as to any portion thereof as to which delay shall have occurred, and may take possession of the work and complete the work by the Contractor or otherwise, as the Owner may deem expedient. In such case, the Contractor shall not be entitled to receive any further payment until the work is finished. If the unpaid balance of the compensation to be paid the Contractor hereunder shall exceed the expense of so completing the work, including compensation for additional managerial, administrative and inspection services and any damages for delay, such excess shall be paid to the Contractor. If such expense shall exceed such unpaid balance, the Contractor and his sureties shall be liable to the Owner for such expenses. If the right of the Contractor to proceed with the work is terminated, the Owner may take possession of and utilize in completing the work such materials, appliances, supplies, drawings, and equipment, as may be on the site of the work and necessary therefore. If the Owner does not terminate the right of the Contractor to proceed, the Contractor shall continue the work.

If the work shall be stopped by order of the Court or any other public authority, for a period of three (3) months without act or fault of the Contractor or of any of his agents, servants, employees, or Subcontractor, the Contractor may, upon ten (10) days notice to the Owner, discontinue his performance of the work and/or terminate the contract, in which event the liability of the Owner to the Contractor shall be determined as provided in the paragraphs immediately preceding, except that the Contractor shall not be obligated to pay to the Owner any excess of the expense of completing the work over the unpaid balance of the compensation to be paid by the Contractor hereunder.

1.12 REFERENCE TO THE STANDARD SPECIFICATIONS

(a) All applicable portions of the work performed under this contract shall comply with the requirements of the current New Jersey Department of Transportation Standard Specifications for Road and Bridge Construction, as amended or supplemented and whose specifications are made part of these specifications. The New Jersey Department of Transportation Standard Construction Details shall govern except insofar as same are expressly modified, amended or changed in detail drawings prepared specifically for this particular project.

(b) The Standard Specifications are made part of these specifications by this reference as if were set forth in full. It is the responsibility of the prospective bidder to be familiar with these Standard Specifications. The Contractor is required to follow only the electronic version, effective September 1, 2019, as referenced in Baseline Document Change announcement BDC19S-01 of the New Jersey Department of Transportation Standard Specifications for Road and Bridge Construction, 2019, unless modified in the technical specifications of this contract. Copies may be examined in the Engineer's office or may be obtained from the New Jersey Department of Transportation.

2.0 INSURANCE

2.01 STATE LAW AND REGULATIONS AND INSURANCE

The Contractor must assume all risks connected with his work. He shall comply with all State Laws and Regulations concerning Workmen's Compensation and shall maintain such insurance as will protect him against all claims for damages for personal injury, including death which may arise during prosecution of the contract, either by himself or by any Subcontractor or anyone directly or indirectly employed by either of them.

2.02 CONTRACTOR'S INSURANCE

The Contractor shall not commence work under this contract, until he has obtained all insurance required under this paragraph and such insurance has been approved by the Owner, nor shall the Contractor allow any Subcontractor to commence work, in his subcontract until all similar insurance required of the Subcontractor has been so obtained and approved.

Insurance coverage shall remain in effect until the project is accepted by the Owner, and at all times thereafter when the Contractor may be removing or replacing defective work.

The Contractor shall furnish the Owner with proof of insurance by execution of the Certificate of Insurance, of which a copy is included herein. The Owner, Remington & Vernick Engineers and the Solicitor shall be a named additional insured.

The Certificate of Insurance shall give the Owner and Engineer 30 days written notice of any material change in, cancellation of, or expiration of the policies.

The following types of insurance are required:

a. General Liability

b. Automobile Liability

c. Excess Liability

d. Worker's Compensation and Employer's Liability

The amounts for property damage and bodily injury for each type of insurance are as shown on the Certificate of Insurance herein.

The Contractor's insurance shall apply to and provide coverage for all Subcontractors and/or suppliers unless the Contractor forwards to the Owner and Engineer the Certificate of Insurance for the Subcontractor and/or supplier.

Any insurance company providing coverage must be licensed, admitted and authorized to do business in the State of New Jersey.

2.03 SUIT OR CLAIMS

The Contractor agrees to indemnify and save harmless the Owner and the Engineer and all their agents and employees from actions and suits of every kind and description brought against them, or on account of the use of patented rights, and from any damages or injuries received or sustained by any party, or parties, arising out of any act or omission of the Contractor, his workmen or agents in performance of the work under this agreement, including the furnishing of equipment, materials and supplies at the site of the proposed work.

2.04 DAMAGES TO PERSONS AND PROPERTY

Contractor shall fully and completely indemnify and same harmless the Owner from damages or injury to persons or property resulting from the performance of the work, or through negligence to the contract, or through the use of any improper or defective machinery implements or appliances or through any act of omission of the Contractor, or his agents, or his employees.

3.0 CONDUCT OF THE WORK

3.01 ROLE OF THE ENGINEER

The Engineer may verify, by observation and/or required tests, the amount, quality, acceptability and fitness of the materials, equipment and supplies furnished; and shall interpret any ambiguities in the drawings and specifications, contract documents, and any extra work order. Upon request, the Engineer shall confirm in writing any oral direction, requirement or determination.

All work of refilling sunken ditches, repaving over trenches and keeping the streets and sidewalks in passable condition shall be satisfactorily performed by the Contractor during the construction of the work as well as during the maintenance period. If any work is not done within 48 hours after written notice given by the Engineer, the work may be done by the Owner and charged to the Contractor.

3.02 SURVEYS

Unless otherwise expressly provided for in the specifications, the Contractor will furnish all surveys necessary for the execution of the work. The Owner will furnish a base line and datum bench marks as required. The Contractor shall measure and lay out his work and be responsible for the accuracy thereof from bench marks and base lines established by the Engineer which shall constitute the surveys hereinbefore referred to. The contractor shall submit cut sheets for curb, sidewalk and roadway construction projects unless specifically waived in writing by the Engineer.

3.03 PRESERVATION OF STAKES

The Contractor shall carefully preserve bench marks, reference points and stakes, and in case of willful or careless destruction, he will be charged with the resulting expense and shall be responsible, for any mistakes that may be caused by their unnecessary loss or disturbance.

3.04 USES OF PREMISES AND REMOVAL OF DEBRIS

The Contractor expressly undertakes at his own expense:

(a) To take every precaution against injuries to persons or damage to property.

(b) To store his apparatus, materials, supplies and equipment in such orderly fashion at the site of the work as will not unduly interfere with the progress of his work or the administration of Owner's affairs.

(c) To place upon the work any part thereof only such loads as are consistent with the safety of that portion of the work.

(d) To frequently clean up all refuse, scrap material and debris caused by his operations and at all times the site of the work shall present a neat, orderly condition.

(e) Before final payment to remove all surplus material, false work, temporary structures, including foundations thereof, plant of any description and debris of every nature resulting from his operations and to put the site in a neat orderly condition.

(f) To affect all cutting, fitting, or patching of his work required to make the same conform to the drawings and specifications, and except with the consent of the Engineer, not to cut or otherwise alter the work.

3.05 INJURY TO EXISTING STRUCTURES

The Contractor shall be responsible for all injury to existing structures met within the prosecution of the work, including the delivery to the site of the proposed improvements of materials and supplies. In case of accident to existing structures met within the prosecution of the work, the Contractor will be required to immediately notify the proper authorities and as soon as possible thereafter also notify the Engineer.

3.06 CORRECTION OF WORK

The Contractor expressly warrants that his work shall be free from any defects in materials or workmanship and agrees to correct any such defects which may appear in such materials or workmanship within two years or the term of the maintenance bond, which ever is longer, following the final acceptance of the work by the Owner, such final acceptance to be evidenced by an appropriate resolution of the governing body in the case of municipal corporation, quasi municipal corporation, municipal board, municipal commission or other municipal authority or by the issuance of final payment in the case of any Owner other than a municipal corporation, quasi municipal corporation, municipal board, municipal commission or other municipal authority.

Neither, the acceptance of the completed work, nor payment therefore shall operate to release the Contractor or his surety or sureties from any obligation or obligations under this contract or the bonds required under these Contract Documents.

3.07 PUBLIC UTILITIES

The contract drawings indicate the approximate location of known overhead and subsurface utilities in the vicinity of the work. The bidder is advised to investigate and ascertain for himself all the facts concerning the actual location of these utilities.

The Contractor shall cooperate with the utility Owners in the adjustment of their facilities and shall notify the utility Owners not less than ten (10) days in advance of the time he proposes to perform any work that will endanger or affect their facilities.

The Contractor shall permit the Owners of utilities, or their agents, access to the site of the work at all times in order to relocate, construct or protect their lines and he shall cooperate with them in performing this work.

Separate payments will not be made for the following:

1. Coordination and cooperation of the Contractor with the utility companies, nor for the protection or replacement of utilities as specified hereinbefore.

2. Damages for delay caused by conflicts with utilities outside the jurisdiction of the Owner (ex: gas mains, telephone or electric lines, county storm sewer, water mains, etc.).

The bidder shall include all such costs in the prices bid for the various scheduled items in the Bid form.

3.08 PROTECTION OF WORK AND PROPERTY

The Contractor shall continuously maintain adequate protection of his work and shall protect Owner's property from injury or loss arising in connection with his work. He shall also protect all adjacent property as provided by law, and shall be responsible for all injury to property and existing structures sustained during the prosecution of his work, including delivery to the site of the equipment, materials and supplies. He shall repair and replace any such damage, injury or loss equal or better than the condition of the item prior to the Contractor's action.

All passageways, guard fences, light and other facilities required for protection by local authorities or local conditions must be provided and maintained.

3.09 CONTRACTOR TO ACT IN AN EMERGENCY

In case of any emergency which threatens loss or injury of property, and/or safety of life, the Contractor is required to act as he sees fit. He shall notify the Engineer thereof immediately thereafter.

3.10 EXTRA WORK

The Contractor further agrees that the Engineer may make such alterations as he may see fit in the form, dimensions, plans for materials of the work, materials and supplies bid upon or any part thereof, either before or after work. If such alterations diminish the quantity of the equipment, materials and supplies to be furnished and delivered to the site or work to be executed, they shall not constitute a claim for damages for anticipated profits on the work that may be dispensed with. If the extra work, change or alteration increases the amount of work to be performed or equipment, they shall be paid for at the price bid. If prices for such extra work are not included in the lump sum prices or unit prices bid, the Contractor hereby agrees to furnish the necessary materials and perform such labor as extra work, and agrees to accept in full payment therefore a price which shall be fixed by the Engineer previous to its commencement. The basis of such price will be the estimated actual cost of materials, labor, equipment, and a maximum 10% overhead plus a maximum 10% profit. Contractor shall furnish a detailed cost breakdown for proposed extra work for

review by the Engineer. The Owner and/or Engineer has the sole authority to unilaterally direct extra work to be performed on a force account basis. The basis of payment for force account work shall be the actual cost of the materials, labor and equipment, and a maximum 10% overhead plus a maximum 10% profit. Contractor shall furnish a detailed cost estimate of the extra work to be paid by force account previous to its commencement. Contractor shall submit daily or shift reports for actual force account costs. Payment for markup on subcontracted work shall be at a maximum rate of 5% of the total amount for all costs on the subcontracted work, for both fixed price and force account extra work. Change Orders and Open End Contracts will be in accordance with N.J.A.C. 5:30-11 et seq.

The Contractor shall not be entitled to receive payment for any extra work unless the same is certified in writing by the Engineer.

3.11 DISPUTE RESOLUTION

For construction contracts, the Owner and Contractor agree that in the event of a dispute arising under this contract, it shall be submitted to a process of resolution pursuant to alternative dispute resolution practices, such as mediation, binding arbitration or non-binding arbitration pursuant to industry standards, prior to being submitted to a Court for adjudication. Nothing in this section shall prevent the contracting unit from seeking injunctive or declaratory relief in court at any time. The alternative dispute resolution practices shall not apply to disputes concerning the bid solicitation or award process, or to the formation of contracts or subcontracts to be entered to pursuant to N.J.S.A. 40A:11-1 et seq. (Local Public Contracts Law).

Notwithstanding industry rules or any provision of law to the contrary, whenever a dispute concerns more than one contract, such as when a dispute in a contract involving design, architecture, engineering or management, upon demand of a contracting party, other interested parties to the dispute shall be joined unless the arbitrator or person appointed to resolve the dispute determines that such a joinder is inappropriate. Notwithstanding industry rules or any provision of law to the contrary, whenever more than one dispute of a similar nature arises under a construction contract, or related construction contracts, upon demand of a contracting party, the disputes shall be joined unless the arbitrator or person appointed to resolve the dispute determines that the disputes are inappropriate for joinder.

During any dispute the Contractor shall diligently proceed with completing the contract unless otherwise directed, in writing, by the Owner or Engineer.

4.0 CONTRACTOR'S PERSONNEL

4.01 PERSONAL ATTENTION

The Contractor shall give his personal supervision to the prosecution of the work, or have a competent representative on the work who shall have written authority to carry out the requirements of the Contract Documents. He shall also supply all manpower, materials and equipment as they may be required in the furnishing and delivery to the site of the proposed work, the equipment, materials and supplies bid upon.

4.02 CONTRACTOR'S SUPERINTENDENT

The Contractor shall attend to the work personally or through a competent, English-speaking superintendent, who shall be continually present on the project site whenever work is in progress. Such a superintendent shall be satisfactory to the Owner and Engineer and shall not be removed or replaced without due notice being given the Owner and Engineer. The Superintendent shall have full authority to act for the Contractor without the need to consult any higher level of authority.

4.03 LABOR LAWS

The Contractor and any Subcontractors shall comply with all the requirements of the Labor Laws of the State of New Jersey applicable to contracts on behalf of this Owner for construction, alteration or repair of any building or public work, including particularly, but without limitation of the foregoing, the provisions of New Jersey Administrative Codes and related statues including N.J.S.A. 10:2-1 to 10:2-4, inclusive and N.J.S.A. 34:11-56.*25* et seq., New Jersey Prevailing Wage Act

The Contractor hereby agrees to comply in all respect with the New Jersey Prevailing Wage Act, N.J.S.A. 34:11-56.25 et seq. as amended. A copy of the prevailing wage rates pertaining to the work and issued by the New Jersey Department of Labor entitled, "Prevailing Wage Rate Determination" is on file in the Engineer's office and is included herein. Pursuant to N.J.S.A. 34:11-56.25 et seq. – New Jersey Prevailing Wage Act, no public works contract may be awarded to any contractor and subcontractor or to any firm, corporation or partnership in which they have an interest on the attached disbarred bidders list located at the end of this specification, until expiration date given. Workmen shall be paid not less than such prevailing wage rate.

In accordance with N.J.A.C. 12:60-9.1, if the Contractor who makes the lowest bid for the contract is 10% or more under the amount of the next lowest bid, they must, prior to the award, certify to the Owner via the "Lowest Bidder Prevailing Wage Certification" that the prevailing wage rates required by the Prevailing Wage Act shall be paid in performing the work under the contract. If the Contractor does not provide the Certification required prior to the award of the contract, the Owner shall award the contract to the next lowest responsible and responsive bidder.

Before final payment is made by or on behalf of the Owner of any sum or sums due to the work, the Contractor or Subcontractor shall file with the treasurer of the Owner, written statements in form satisfactory to the Commissioner of Labor certifying to the amounts then due and owing from such contractor or subcontractor filing such statement to any and all workmen for wages due on account of the work, setting forth therein the names of the persons whose wages are unpaid and the amount due to each respectively which statement shall be certified by the oath of the Contractor or Subcontractor as the case may be in accordance with the said New Jersey Prevailing Wage Act.

The prevailing wage rate shall be determined by the Commissioner of Labor or his duly authorized representative.

Contractors or Subcontractors performing public work of a public body subject to the provisions of this act shall post the prevailing wage rates for each craft and classification involved as determined by the Commissioners of Labor including the effective date of any changes thereof, in prominent and easily accessible places at the site of the work or at such place or places as are used by them to pay workmen their wages.

In the event it is found that any workmen, employed by the Contractor or any Subcontractor, on this project, has been paid a rate of wages less than the prevailing wage required, the Department of Labor along with the Owner may terminate the Contractor's or Subcontractor's right to proceed with the work or such part of the work as to which there has been a failure to pay required wages and to prosecute the work to completion or otherwise, the Contractor and his surety(ies) shall be liable to the Department of Labor along with the Owner for any excess costs occasioned thereby.

Prior to final payment, the Contractor shall be required to execute and deliver an Affidavit of Compliance in a form provided by the Engineer, as required by the Act.

4.04 CONTRACTOR'S EMPLOYEES

All workmen must be competent and fully qualified in the type of work to be performed. Any employee of the Contractor, who is found by the Engineer to be incompetent, or who is performing his work in an unsightly

manner or contrary to the specifications or the Engineer's instructions, or who is disorderly, shall be removed from the project and shall not again be employed on the project without the Engineer's consent.

4.05 EIGHT HOUR DAY: PREVAILING WAGE RATE

All mechanics, workers, laborers, employed or engaged in the work hereunder shall work no more than eight (8) hours in any one day. In case of necessity for the protection of property or human life, mechanics, workmen and laborers may be employed for longer periods than eight hours per calendar day, if paid extra compensation on the basis of eight hours, constituting a days work, in accordance with the Prevailing Wage Act, N.J.S.A. 34:11-56-25 et seq., and all State and Federal laws.

4.06 PAYMENT OF EMPLOYEES

The Contractor and each of his Subcontractors shall pay each of his employees engaged in work on the project under this contract in full (less deductions made mandatory by law) in legal tender and not less often than once each month.

4.07 SAFETY AND HEALTH REGULATIONS

The Contractor shall comply with the Department of Labor, Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (P.L.91-596) and under Section 107 of the Contract Work Hours and Safety Standards for Construction (P.L.91-54).

4.08 ACCIDENT PREVENTION

Precautions shall be exercised at all times for the protection of persons (incl. employees) and property. The safety provisions of applicable laws, buildings and construction codes shall be observed. Machinery, equipment, and all hazards shall be guarded or eliminated in accordance with the safety provisions of the Manual of Accident Prevention in Construction published by the Association General Contractors in America and Part VI "Temporary Traffic Control" of the U.S. Dept. of Transportation. Federal Highway Administration "Manual on Uniform Traffic Control Devices", latest edition, whichever is more stringent to the extent that such provisions are not in contravention of applicable law. Contractor alone shall be responsible for the safety, efficiency, and adequacy of his plant, appliances and methods and for any damage which may result from their failure for their improper construction, maintenance or operation. The cost of "Accident Prevention" shall be included in the lump sum or unit price bid whichever is applicable.

5.0 MATERIALS

5.01 CONTRACTOR'S TITLE TO MATERIALS

No materials or supplies for the work shall be purchased by the Contractor or by Subcontractor that are subject to any chattel mortgage or under a conditional sale or other agreement by which an interest is retained by the seller. The Contractor warrants that he has good title to all materials and supplies used by him in the work.

5.02 ROYALTIES AND PAYMENTS

The Contractor shall pay all royalties and license fees. He shall defend all suits or claims for infringements of any patent rights and shall save the Owner harmless from loss or account thereof.

5.03 USE OF DOMESTIC MATERIAL

In the performance of the work, the Contractor and all Subcontractors shall use only manufactured materials and farm products of the United States of America, wherever available.

All Contractors and Subcontractors shall comply with the provisions of N.J.S.A. 40A:11-18, which relate to the use of domestic materials.

5.04 ORDERING MATERIALS

Before ordering materials, the Contractor shall obtain the Engineer's approval of their conformity to the specifications. In the case of concrete aggregate, and similar materials, samples must accompany the request for approval. The Contractor must forward to the Engineer copies of all shipping lists, invoices or delivery slips accompanying such deliveries.

5.05 SAMPLES

The Contractor shall submit to the Engineer any samples of materials before or during the progress of the work that may be required by the Contract Documents and all materials and workmanship must be equal in every respect to the samples submitted and approved.

5.06 SHOP OR SETTING DRAWINGS

(a) The Contractor shall submit promptly eight copies, of which two will be returned to the contractor, of each shop or setting drawings prepared in accordance with the schedule predetermined under the provisions of the preceding paragraph hereof with the Contractor's approval stamp and date thereon. After examination of such drawings by the Engineer, and the return thereof, the Contractor shall make such corrections to the drawings as have been indicated and shall furnish the Engineer with eight corrected copies. If requested by the Engineer, the Contractor must furnish additional copies, regardless of corrections made in or approval given to such drawings by the Engineer. The Contractor will nevertheless be responsible for the accuracy of such drawings and for their conformity to the drawings and specifications unless he notified the Engineer in writing of any deviations, at the time he furnished such drawings. Shop drawing requirements as detailed within the technical specifications and scope of work shall govern should they be in conflict with the General Conditions.

(b) The Contractor shall likewise submit, in writing, the type, kind and name of the manufacturer of all materials to be used in the work for the written approval of the Engineer prior to the installation of same.

(c) Any equipment or materials installed without this written approval of the Engineer will be required to be removed by the Contractor at his own expense and replaced with equipment and materials as approved.

5.07 ADDITIONAL INSTRUCTIONS AND DETAIL DRAWINGS

The Contractor will be furnished additional instructions and detail drawings to carry out the work included in the contract as required. The additional drawings and instructions thus supplied, to the Contractor, will coordinate with the contract documents and will be so prepared that they can be reasonably interpreted as a part thereof. The Contractor shall carry out the work in accordance with the additional detail drawings and instructions.

The Contractor and the Engineer will prepare, jointly (a) a schedule fixing the date at which special drawings will be required and by whom they will be made, such drawings, if any, to be furnished by the Engineer in accordance with said schedule, and (b) a schedule fixing the respective dates for the submission of shop or setting drawings; the beginning of manufacture, testing and installation of materials, supplies and equipment and the completion of the various parts of the work, each such schedule to be subject to change from time to time in accordance with the progress of the work.

5.08 OR EQUAL CLAUSES

Wherever in these contract documents a particular brand, make of materials, device or equipment is shown or specified, such brand, make of material, device or equipment should be regarded merely as a standard.

When a bidder submits an equivalent, it shall be the responsibility of the bidder to document the equivalence claim.

Failure to submit such documentation shall be grounds for rejection of the claim of equivalence.

If two or more brands, makes of material, devices or equipment are shown or specified, each should be regarded as the equal of the other. Any other brand, make of material, devices or equipment, which in the opinion of the Engineer is the recognized equal of that specified, considering quality, workmanship and economy of operation, and is suitable for the purpose intended, will be accepted. All material and workmanship shall, in every respect be in accordance with what, in the opinion of the Engineer is in conformity with approved modern practice.

Whenever the drawings, specifications or other contract documents or the direction of the Owner or its authorized agent admit of doubt as to what is permissible, and/or fail to note the quality of any work, that interpretation will be made by the Engineer which is in accordance with approved modern practice to meet the particular requirement of the contract.

In all cases, new materials shall be used unless this provision is waived by notice from the Engineer.

5.09 SUBSTITUTIONS

After the execution of the contract, substitution of equipment or materials of makes other than those named in the contract will be considered for one reason only. That the equipment proposed for substitution is superior or equal in construction and/or efficiency to that named in the contract.

Complete data, to include: shop drawings, specifications, performance curves, test results, list of similar installation with years of service, operating and maintenance instruction, a statement that the Contractor agrees to pay all costs that will result directly or indirectly from acceptance of the substitute, and all other necessary information; shall be submitted in triplicate to enable the Engineer to evaluate the proposed substitution equipment or material. The determination as to whether or not such changes will be permitted rests solely with the Engineer.

The Contractor shall take and assume full responsibility and bear any extra expense or cost incurred by changes advocated by him. Those costs include, but are not limited to, review time by the Engineer or the Engineer's Consultants, costs of redesign, and claims of other contractors affected by the resulting change. It will be assumed that the cost to the Contractor of the equipment or materials proposed to be substituted is less than the equipment or materials named in the contract, and if the substitution is approved, the contract price shall be reduced by an amount equal to the savings.

5.10 MATERIAL SAFETY DATA

In accordance with the requirements of N.J.S.A. 34:5A-1 et seq., "Workers and Community Right to Know Act", the State Department of Health has adopted a Workplace Hazardous Substance List (N.J.A.C. 8:59-9) which includes substances that pose a threat to the health and safety of employees. Therefore, under the provisions of N.J.A.C. 8:59-7, the contractor must furnish the Owner a "Material Safety Data Sheet" for each product which is supplied to the Owner which contains a substance listed on the Hazardous Substance List (N.J.A.C. 8:59-9). The Owner reserves the right to request a copy of the applicable Material Safety Data Sheet be forwarded with the delivery of each product. Furthermore, under the provisions of N.J.A.C. 8:59-5, each

product shall have a label affixed or stenciled onto any container that contains any substance listed on the Hazardous Substance List (N.J.A.C. 8:59-9).

6.0 INSPECTION AND TESTING

6.01 INSPECTION

The Contractor shall afford every facility for inspection of the equipment, materials and supplies at all times by the Engineer prior to the delivery of same to the site of the work. All equipment, supplies and materials shall be tested in the presence of the Engineer, if so desired.

Any equipment, materials, supplies or workmanship deemed of inferior quality, or not in accordance with the finally approved specifications, brought to or incorporated in the work may be rejected by the Engineer. The equipment, materials and supplies and workmanship may be re-inspected at any time, prior to delivery to the site of the proposed improvements. The Contractor shall bear all the expense of testing materials.

When construction is not continuous through the normal work week, (Monday through Friday), Contractor must notify the Engineer at least 24 hours in advance of any stopping or starting of the work. Notification may be by writing, telephone, facsimile, telegraph or personal visit to the Engineer's listed office.

Contractor shall notify Engineer at least forty-eight (48) hours in advance to any work on Saturdays. There will be no work permitted on Sundays or holidays. If the project receives inspection by the Engineer, the normal working hours for the Engineers inspector are from 7:30 a.m. to 4:00 p.m., Monday through Friday. Any overtime inspection costs for the Engineers inspector which are avoidable shall be reimbursed by the Contractor.

Should the contractor have an emergency or need to cancel scheduled work, notification of the cancelled work must be received by the Engineer's inspector no later than 6:00 am the morning of the cancellation. Failure of the contractor to provide the required notification will require the contractor to pay for eight (8) hours of inspection at the rate of the Engineer's local inspector. The costs for cancellation of inspection without the required notification will be deducted from the contractor's payment application.

As the Owner is only paying for the contract time in the Contract Documents, the Contractor shall be responsible for all costs of inspection and contract management beyond the contract time limits, unless a written extension of time has been granted by the Owner. These costs are in addition to any liquidated damages that may be charged to the Contractor.

6.02 DAILY REPORTS

On a daily basis, the Contractor shall have his Authorized Representative complete, sign and present the Engineer with a Certificate of Site Safety Conditions, attached hereto as Form GC-6.02S.

At the Engineers discretion, the Contractor may be directed to furnish a daily report, on a form, which will include the date, the weather, a general description of the work performed, line item quantities involved, number and skill type of workers, equipment utilized, location of work, and any pertinent remarks affecting the work.

6.03 INSPECTORS

The work shall be conducted under the general observation of the Engineer through such Inspectors as the Engineer employs. Inspectors are stationed on the site of the work to represent the Engineer and to report to him concerning the observation of progress of the work and the workmanship and materials being furnished. Such Inspectors shall inform the Engineer and the Contractor when they observe that work being performed and/or the materials being furnished do not conform to the requirements of the Contract Documents. Such

observation, if and when provided, shall not relieve the Contractor of any responsibility to furnish materials and perform work in complete accordance with the requirements of the Contract Documents, nor does such observation create any duty or obligation to any employee or invitee of Contractor, any Subcontractor, or to any third party. The Contractor is prohibited from relying upon the Engineer's site inspections or raising the engineer's observations as a defense to claims of defective work.

The Inspector is not authorized to revoke, alter, enlarge, relax or release any requirements of the Contract Documents or to issue instructions contrary to the Contract Documents.

6.04 ACCESS TO THE WORK

The Contractor shall furnish the Engineer with every reasonable facility for observing the work as performed.

The Engineer shall have the right to inspect all work done and all materials furnished either in the field or at the point of manufacture. The Contractor shall furnish or cause to be furnished safe access at all times to the places where preparation, fabrication or manufacture of materials and/or construction of the work is in progress.

When the Engineer or his representative are in or about the premises mentioned above in the course of their duties, they shall be deemed conclusively to be an invitee of the Contractor. If the Contractor is not the Owner of the premises mentioned above, the Owner thereof shall be deemed an agent of the Contractor with respect to the obligation assumed hereby. The Contractor or his agent, as described above, shall be liable for the payment of claims for injuries, damages, etc, for death of the Owner or his representative due to the negligence on the part of the Contractor or his agent.

6.05 COVERING UNINSPECTED WORK

If any work be buried, covered or otherwise concealed prior to observation by Engineer or contrary to the orders and direction of the Engineer and such work is not subject to testing and approval by any acceptable alternate method it must, if required by the Engineer, be uncovered for examination. Such uncovering and all necessary restoration regardless of the final acceptability of the work, uncovered, shall be at the expense of the Contractor.

6.06 TESTING MATERIALS

Except as may be provided elsewhere, tests or analysis of materials which are usually tested after delivery to the site, such as concrete aggregate, mixed-in-place concrete, and similar materials; will be performed by the Engineer or testing laboratories which will be approved by the Engineer and selected and paid for by the Contractor. The preliminary testing of concrete mixtures and tests or analysis of other materials, samples of which are to be submitted prior to delivery, will also be performed by the laboratory and paid for by the Contractor at the Engineer's request.

If the Engineer orders sampling and analysis or tests of materials which are usually accepted on certification of the manufacturer but which appear defective or not conforming to the requirements of the Specifications, the Contractor will bear the reasonable costs of sampling, transportation, tests and analysis.

7.0 PAYMENTS

7.01 CONSTRUCTION SCHEDULE AND PERIODIC ESTIMATES

Immediately after execution and delivery of the contract, and before the first partial payment is made, the Contractor shall deliver to the Engineer an estimated construction progress schedule in form satisfactory to the Engineer, showing proposed dates of commencement and completion of each of the various subdivisions of work required under the Contract Documents and the anticipated amount of each monthly payment that will

become due to the Contractor in accordance with the progress schedule. The Contractor shall update the schedule each time a change is approved, but at a minimum every 30 days. An updated schedule shall be submitted with the Contractor's payment application. Should a payment application be submitted without an updated schedule, payment processing may be delayed. The Contractor shall also furnish the Engineer (a) a detailed estimate giving a complete breakdown of the contract price on Lump Sum Contracts and (b) periodic itemized estimates of work done for the purpose of making partial payments thereon. The costs employed in making up any of these schedules are to be used in determining the basis of partial payments.

Approval of the progress schedule by the Engineer does not modify the Contract or constitute Acceptance of the feasibility of the Contractor's logic, activity durations, or assumptions used in creating the schedule. If the schedule reflects a completion date different than that defined by the date of Notice to Proceed and Contract Time, this does not change the specified completion date. If the Engineer approves a schedule that reflects a completion date earlier than that specified as the Contract Time, the Owner will not accept claims for additional Contract Time or compensation as the result of failure to complete the Work by the earlier date shown on the progress schedule. Float is the amount of time that an activity may be delayed from its early start without delaying Completion. Float belongs to the Project and is not for the exclusive use of the Contractor or the Owner.

7.02 PAYMENTS

Unless otherwise specified, on the first day of each month or within thirty (30) days thereafter, the Engineer will estimate approximately the value of the work performed, and equipment, materials and supplies delivered on the ground inspected and accepted during the preceding month, according to these specifications, less any retainage, and shall be certified by the Engineer for payment to the Contractor. The value of the work, as estimated, will be determined by the lump sum and/or unit price bid. Requests for payment for materials on hand shall be accompanied with receipted invoice from supplier. Prior to such payment being made, the Contractor shall execute an agreement, provided by the Engineer and Solicitor on behalf of the Owner, which details the conditions of payment.

If, in the opinion of the Engineer, it is undesirable to replace any defective or damaged materials or to reconstruct or correct any portion of the work injured or not performed in accordance with the contract documents, the compensation to be paid to the Contractor hereunder shall be reduced by such amount as in the judgment of the Engineer shall be equitable.

No request for payment shall be approved until a Certification of Site Safety Conditions showing no unsafe conditions for each day worked in the payment request period has been furnished by the Contractor. When the work performed under this contract has been completed by the Contractor and accepted by the Owner, the Engineer shall make a final estimate of the work and certify the same to the Owner which shall for causes herein specified, pay to the Contractor the balance due, excepting therefrom such sum as may be lawfully retained under any provisions of this contract. All prior estimates and payments including those relating to extra work shall be subjected to corrections by this payment.

The Owner shall pay the amount due to the prime contractor for each periodic payment, final payment or retainage monies not more than 30 calendar days after the billing date, except as provided herein, which for periodic billing shall be established at the pre-construction meeting and memorialized in the minutes of the pre-construction meeting. The billing shall be deemed approved and certified 20 days after the Owner or Owner's Representative receives it, as indicated by the date stamped received on the billing by the Owner or Owner's Representative, except as provided herein, unless the Owner or Owner's Representative provides, before the end of the 20 day period, a written statement of the amount withheld and the reason for withholding payment. The Owner is a public or governmental agency that requires the governing body to vote on authorizations for each periodic payment, final payment or retainage monies, the amount due may be approved and certified at the next scheduled public meeting of the Owner's governing body, and paid during the Owner's subsequent payment cycle.

7.03 RETAINAGE

The Contractor is advised that for contracts $100,000.00 and under for improvement to real property, the sum of 10% of the amount due shall be held on each partial payment pending completion of the project.

The Contractor is advised that the Local Public Contracts Law, N.J.S.A. 40A:11-1 et seq., are applicable if the total amount of the contract awarded for this project exceeds $100,000.00. The provisions of N.J.S.A. 40A:11-1 et seq., provide that the Contractor may:

1. Agree to the withholding of payments in the manner prescribed in the contract, or may deposit with the contracting unit registered book bonds, entry municipal bonds, State bonds or other appropriate bonds of the State of New Jersey, or negotiable bearer bonds or notes of any political subdivision of the State, the value of which is equal to the amount necessary to satisfy the amount that otherwise would be withheld pursuant to the terms of the contract. The nature and amount of the bonds or notes to be deposited shall be subject to approval by the contracting unit. For the purposes of this section, "value" shall mean par value or current market value, whichever is lower.

2. Such agreement will be indicated by signing of estimate or payment certificates unless written communication to the contrary is made to the Owner and Engineer, or

If the Contractor agrees to the withholding of payments, the amount withheld shall be deposited, with a banking institution or savings and loan association insured by an agency of the Federal Government, in an account bearing interest at the rate currently paid by such institutions or associations on time or savings deposits. The amount withheld, or the bonds or notes deposited, and any interest accruing on such bonds or notes, shall be returned to the contractor upon fulfillment of the terms of the contract relating to such withholding, Any interest accruing on such cash withholdings shall be credited to the Owner.

Furthermore, N.J.S.A. 40A:11-1 et seq. provides that for contracts over $100,000.00 for improvement to real property:

1. From the total amounts due as ascertained through a current Engineer's estimate will be deducted an amount equivalent to two percent (2%) of the amount due on each partial payment shall be withheld by the Owner pending completion of the contract.

2. Upon acceptance of the work performed pursuant to the contract for which the contractor has agreed to the withholding of payments pursuant to this section, all amounts being withheld by the Owner shall be released and paid in full to the contractor as required by law after final acceptance by the Owner, without further withholding of any amounts for any purpose whatsoever, provided that the contract has been completed as indicated.

7.04 ACCEPTANCE OF FINAL PAYMENT AS RELEASE

The acceptance by the Contractor of final payment shall be and shall operate as the Contractor's release of the Owner from all claims and all liability to the Contractor, other than claims in stated amounts as may be specifically excepted by the Contractor, for all things done or furnished in connection with the work and for every act and neglect of the Owner, or Owners designee and others relating to or arising out of this work. Any payment, however, final or otherwise, shall not release the Contractor or its sureties from any obligations under the contract documents, and/or arising out of performance of the work, and/or arising out of the obligations undertaken by the surety under performance, payment and/or maintenance bonds.

7.05 OWNER'S RIGHT TO WITHHOLD PAYMENTS

Owner may withhold from the Contractor as much of any approved payments due him, as may, in the judgment of the Owner, be necessary, to

(a) Secure the payment of just claims then due and unpaid by any persons supplying labor or materials for the work.

(b) Protect the Owner from loss due to defective work not remedied, or

(c) Protect the Owner from loss due to injury to persons or damage to the work or property of other Contractors, Subcontractors or others caused by the act or neglect of the Contractor or any of his Subcontractors that the Owner may deem proper to satisfy such claims or to secure such protection. Such application of such money shall be deemed payment for the amount of the Contractor.

(d) Protect the Owner from enforcement action by others or from being in non-compliance with laws or regulations due to the failure of the Contractor to supply the Engineer and or Owner with Monthly Manning Reports, Certified Payroll Reports or other submittals required by the Engineer or Owner.

7.06 COSTS OF ENGINEERING AND INSPECTION

There will be deducted from the contract and retained by the Owner an amount to defray the cost of wages and overhead paid by the Owner to the Resident Engineer, Inspector or Inspectors employed on the work for any avoidable time in excess of eight (8) hours per day or on Saturdays, Sundays or legal holidays. This amount shall be determined at the rate of the hourly rate contract with the Owner per man hour for each Inspector or Resident Engineer for, in excess of 8 hours per day and at the rate of the hourly rate contract with the Owner per man hour for Saturday, Sunday and Holidays for each Inspector or Resident Engineer.

In addition, there will be deducted from the contract and retained by the Owner an amount equal to the cost paid by the Owner to the Engineer, for all inspection and contract administration performed in excess of the completion time stipulated for the contract, or as amended by approved change orders.

7.07 LIENS

Final payment of retained percentage shall not become due until the Contractor, shall furnish the Owner a complete release of liens arising out of his contract, or receipts in full, in lieu thereof covering claims of any kind or character for work or labor done, or labor or materials furnished by the Subcontractor, materialmen, persons or corporations whatsoever. The form attached entitled “Full Release and Waiver of Liens” shall be submitted with the final voucher prior to final payment.

7.08 PREVAILING WAGE PAYMENT CERTIFICATE

The form attached hereto, entitled "Prevailing Wage Payment Certification" shall be executed by the Contractor and submitted with the final voucher prior to final payment.

7.09 CERTIFIED PAYROLL REPORTS

The Contractor shall submit original certified payroll reports within 10 days of the payment of wages to the Owner with a copy to the Owners designee, in compliance with N.J.A.C. 12:60.

8.0 VALUE ENGINEERING CONSTRUCTION CHANGE ORDERS

8.01 IMPLEMENTATION OF VALUE ENGINEERING

In accordance with N.J.S.A. 40A:11-16.6 a contractor may submit a Value Engineering Construction Proposal (VECP) after the award of a contract for a project for structures or other improvements to real property, other than work affecting a public building, that exceed $5,000,000. This includes most public works projects, such as utility and environmental systems, road construction and repair, etc., but not building construction, improvements, or renovation. A VECP is a cost reduction proposal based on analysis by a contractor of the functions, systems, equipment, facilities, services, supplies, means and methods of construction, and any other item needed for the completion of the contract consistent with the required performance, quality, reliability, and safety.

8.02 STATUTORY PROVISIONS

a. Value engineering construction change orders shall not be used to impair any of the essential functions, or characteristics of the project, or any portion of the work involved.

b. The contractor shall submit a value engineering construction proposal that completely describes the changes to the original specifications or proposal, impact on other project components, advantages and disadvantages of the proposed change, cost estimates and calculations on which they are based, any impact on the contract time schedule, and any other relevant information that the contracting unit may require in order to review the value engineering construction proposal. The contractor's cost for developing the value engineering construction proposal shall not be eligible for reimbursement by the contracting unit.

c. The contractor shall be liable for all reasonable costs incurred by the contracting unit for the technical evaluation and engineering review of a value engineering construction proposal presented by the contractor.

d. The contracting unit's engineer shall prepare a written report for the governing body that shall evaluate the value engineering construction proposal, make a recommendation on whether or not it should be accepted, rejected, or modified, and state to the contracting unit and contractor the amount of any projected cost savings.

e. The proposal shall not be approved unless the engineer reports to the governing body that the proposal appears consistent with the required performance, quality, reliability, and safety of the project and does not impair any of the essential functions, or characteristics of the project, or any portion of the work involved.

f. The contracting unit shall have the sole discretion to approve or disapprove a value engineering construction proposal.

g. The contractor and the contracting unit shall equally share in the cost savings generated on the contract as a result of an approved value engineering construction change order. Once the project is completed, the contracting unit's engineer shall verify the cost savings to reflect the actual cost of the work, and such verified cost saving shall be the basis for the savings shared equally with the contractor.

h. The contractor shall have no claim against the contracting unit as a result of the contracting unit's disapproval of a value engineering construction proposal.

8.03 PROCEDURES

An initial submission is required to use the Value Engineering process. The initial proposal shall outline the general technical concepts associated with the proposal and the estimated savings that will result.

The initial proposal will be reviewed by the Owner and, if found to be conceptually acceptable, approval to submit a final proposal will be granted by the Owner. A finding of conceptual acceptability of the initial proposal in no way obligates the Owner to approve the final proposal. The Contractor shall have no claim against the Owner as a result of the rejection of any such final proposal.

Final proposals will be considered only after Owner approval of the initial proposal.. Final proposals will not be considered if submitted after 50 percent completion of the Work has occurred, based on monthly estimates amounting to more than 50 percent of the total Contract price (subject to any approved adjustments), unless the remaining Contract Time is one year or more.

Proposals will not be considered that change the following:

a. The type, thickness, or joint designs of a concrete, or HMA surface, intermediate, or base course.

b. The types and thicknesses of the unbound materials underlying a concrete, or HMA surface, intermediate, or base course.

c. The basic design of bridges, defined as the type of superstructure and substructure, span length type and thickness of deck, type of beam and arrangement, geometrics, width, and underclearance.

d. The basic design of retaining walls.

e. The basic design of overhead sign supports and breakaway sign supports.

f. The type of noise barriers.

g. Special architectural aesthetic treatments of structures.

All proposals for changes to bridges and structures shall conform to the current AASHTO Standard Specifications for Highway Bridges as modified by the NJDOT Design Manual for Bridges and Structures.

As a minimum, the following materials and information shall be submitted with each final proposal plus any additional information requested by the Owner:

a. A statement that the final proposal is submitted as a Value Engineering proposal.

b. A description of the difference between the existing Contract requirements and the proposed change, and the comparative advantages and disadvantages of each, including considerations of safety, service life, economy of operations, stage construction, ease of maintenance, and desired appearance.

c. Complete plans, specifications, and calculations showing the proposed revisions relative to the original Contract features and requirements. If the proposal is approved, the Contractor shall submit drawings, in ink, on polyester film such as Mylar or Herculene, 4 mils thick, matted on both sides except as follows:

   (1) Structural drawings may be submitted in pencil.

   (2) Electrical drawings may be matted on one side and may be submitted in pencil.

   (3) Cross-section sheets may be 3 mils thick and may be matted on one side.

   All plans and engineering calculations shall bear the signature of a Professional Engineer licensed to practice in the State.

d. A complete cost analysis indicating the final estimated costs and quantities to be replaced by the proposal, the new costs and quantities generated by the final proposal, and the cost effects of the proposed changes on operational, maintenance, and other considerations.

e. A specific date by which a Change Order adopting the final proposal must be executed so as to obtain the maximum cost reduction during the remainder of the Contract. This date must be selected to allow the Owner ample time, usually a minimum of 45 days, for review and processing a Change

Order. Should the Owner find that insufficient time is available for review and processing, it may reject the final proposal solely on such basis.

f. A statement as to the effect the final proposal has on the Contract Time.

g. A description of any previous use or testing of the final proposal on another Owner project or elsewhere and the conditions and results therewith. If the final proposal was previously submitted on another Owner project, indicate the date, the project, and the action taken by the Owner.

h. The proposal shall not be experimental in nature but shall have been proven to the Owner's satisfaction under similar or acceptable conditions on another Owner project or at another location acceptable to the Owner.

Proposals will be considered only after Award of Contract and only when all of the following conditions are met:

a. The Contractor is cautioned not to base any bid prices on the anticipated approval of a proposal and to recognize that such proposal may be rejected. In the event of rejection, the Contractor is required to complete the Contract according to the original Plans and Specifications and the prices initially bid and accepted by the Governing Body.

b. All proposals, approved or not approved by the Owner for use in the Contract, apply only to the ongoing Contract or Contracts referenced in the proposal. The proposals shall become the property of the Owner and shall contain no restrictions imposed by the Contractor on their use or disclosure. The Owner will have the right to use, duplicate, and disclose in whole or in part any data necessary for the utilization of the proposal. The Owner retains the right to use any accepted proposal or part thereof on any other or subsequent project without any obligation to the Contractor. This provision is not intended to deny rights provided by law with respect to patented materials or processes.

c. If the Owner already has under consideration certain revisions to the Contract that are subsequently incorporated in a proposal, the Owner will reject the Contractor's proposal and may proceed with such revisions without any value engineering obligation to the Contractor.

d. The Contractor shall make no claim against the Owner or Owner's agents for any costs or delays due to the Owner's rejection of a proposal, including but not limited to development costs, anticipated profits, or increased materials or labor costs resulting from delays in the review of such proposal.

e. The Engineer will determine whether a proposal qualifies for consideration and evaluation. The Owner may reject any proposal which is not consistent with the basic design criteria for the Project.

f. The Engineer may reject all or any portion of Work performed pursuant to an approved proposal if the Engineer determines that unsatisfactory results are being obtained. The Engineer may direct the removal of such rejected Work and require the Contractor to proceed according to the original Contract requirements without reimbursement for any Work performed under the proposal, or for its removal. Where modifications to the proposal are approved to adjust to field or other conditions, reimbursement is limited to the total amount payable for the Work at the Contract prices as if it were constructed according to the original Contract requirements. Such rejection or limitation of reimbursement does not constitute the basis of any claim against the Owner for delay or for any other costs.

g. Proposals will be considered only if equivalent options are not already provided in the Contract Documents.

h. The proposal shall be made based on items of work scheduled to be done by the Contractor. Anticipated cost savings based on revisions of utility relocations or other similar items to be done by others will not be considered. Proposals that may increase the cost of Work done by others may be considered.

i. If additional information is needed to evaluate proposals, this information must be provided in a timely manner. Such additional information could include, where design changes are proposed, results of field investigations and surveys, design computations, and field change sheets.

The contracting unit's engineer shall prepare a written report for the governing body that shall evaluate the value engineering construction proposal, make a recommendation on whether or not it should be accepted, rejected, or modified, and state to the contracting unit and contractor the amount of any projected cost savings.

a. The proposal shall not be approved unless the Engineer reports to the Owner's governing body that the proposal appears consistent with the required performance, quality, reliability, and safety of the project and does not impair any of the essential functions, or characteristics of the project, or any portion of the work involved.

b. If the Owner fails to respond to the final proposal by the date specified, the Contractor shall consider the final proposal rejected and shall make no claim against the Owner as a result thereof.

c. The Owner shall have the sole discretion to approve or disapprove a value engineering construction proposal.

If the proposal is accepted, the changes will be authorized by Change Order. Payment will be made as follows:

a. The changes will be incorporated into the Contract by adjustments in the quantities of Pay Items, agreed upon Extra Work Items or by Force Account, as appropriate, according to the Specifications.

b. Once the project is completed, the contracting unit's engineer shall verify the cost savings to reflect the actual cost of the work, and such verified cost saving shall be the basis for the savings shared equally with the contractor. The costs of such verification shall be borne equally by both parties.

c. The Owner's costs for review and processing of the proposal will be deducted from the savings. The cost of the Engineer to verify the savings shall be apportioned equally between the parties.

d. A Contractor's costs for development, design, and implementation of the proposal are not eligible for reimbursement.

e. The Contractor may submit proposals for an approved Subcontractor, provided that reimbursement is made by the Owner to the Contractor and that the terms of the remuneration to the Subcontractor are satisfactorily negotiated and accepted before the proposal is submitted to the Owner. Subcontractors may not submit a proposal except through the Contractor.

9.0 DIFFERING SITE CONDITIONS PROVISIONS (N.J.S.A. 40A:11-16.7)

a. Differing Site Conditions Provisions:

(1) If the contractor encounters differing site conditions during the progress of the work of the contract, the contractor shall promptly notify the contracting unit in writing of the specific differing site conditions encountered before the site is further disturbed and before any additional work is performed in the impacted area.

(2) Upon receipt of a differing site conditions notice in accordance with Section 9.0(a)1 of this subsection, or upon the contracting unit otherwise learning of differing site conditions, the contracting unit shall promptly undertake an investigation to determine whether differing site conditions are present.

(3) If the contracting unit determines different site conditions that may result in additional costs or delays exist, the contracting unit shall provide prompt written notice to the contractor containing directions on how to proceed.

(4) (a) The contracting unit shall make a fair and equitable adjustment to the contract price and contract completion date for increased costs and delays resulting from the agreed upon differing site conditions encountered by the contractor.

(b) If both parties agree that the contracting unit's investigation and directions decrease the contractor's costs or time of performance, the contracting unit shall be entitled to a fair and equitable downward adjustment of the contract price or time of performance.

(c) If the contracting unit determines that there are no differing site conditions present that would result in additional costs or delays, the contracting unit shall so advise the contractor, in writing, and the contractor shall resume performance of the contract, and shall be entitled to pursue a differing site conditions claim against the contracting unit for additional compensation or time attributable to the alleged differing site conditions.

(5) Execution of the contract by the contractor shall constitute a representation that the contractor has visited the site and has become generally familiar with the local conditions under which the work is to be performed.

(6) As used in this subsection, "differing site conditions" mean physical conditions at the contract work site that are subsurface or otherwise concealed and which differ materially from those indicated in the contract documents or are of such an unusual nature that the conditions differ materially from those ordinarily encountered and generally recognized as inherent in the work of the character provided for in the contract.

b. Suspension of Work Provisions:

(1) The contracting unit shall provide written notice to the contractor in advance of any suspension of work lasting more than 10 calendar days of the performance of all or any portion of the work of the contract.

(2) If the performance of all or any portion of the work of the contract is suspended by the contracting unit for more than 10 calendar days due to no fault of the contractor or as a consequence of an occurrence beyond the contracting unit's control, the contractor shall be entitled to compensation for any resultant delay to the project completion or additional contractor expenses, and to an extension of time, provided that, to the extent feasible, the contractor, within 10 calendar days

following the conclusion of the suspension, notifies the contracting unit, in writing, of the nature and extent of the suspension of work. The notice shall include available supporting information, which information may thereafter be supplemented by the contractor as needed and as may be reasonably requested by the contracting unit. Whenever a work suspension exceeds 60 days, upon seven days' written notice, either party shall have the option to terminate the contract for cause and to be fairly and equitably compensated therefore.

(3) Upon receipt of the contractor's suspension of work notice in accordance with Section 9.0(A)2 of this subsection, the contracting unit shall promptly evaluate the contractor's notice and promptly advise the contractor of its determination on how to proceed in writing.

(4) (a) If the contracting unit determines that the contractor is entitled to additional compensation or time, the contracting unit shall make a fair and equitable upward adjustment to the contract price and contract completion date.

(b) If the contracting unit determines that the contractor is not entitled to additional compensation or time, the contractor shall proceed with the performance of the contract work, and shall be entitled to pursue a suspension of work claim against the contracting unit for additional compensation or time attributable to the suspension.

(5) Failure of the contractor to provide timely notice of a suspension of work shall result in a waiver of a claim if the contracting unit can prove by clear and convincing evidence that the lack of notice or delayed notice by the contractor actually prejudiced the contracting unit's ability to adequately investigate and defend against the claim.

c. Change in Character of Work Provisions:

(1) If the contractor believes that a change directive by the contracting unit results in a material change to the contract work, the contractor shall so notify the contracting unit in writing. The contractor shall continue to perform all work on the project that is not the subject of the notice.

(2) Upon receipt of the contractor's change in character notice in accordance with paragraph (1) of this subsection, the contracting unit shall promptly evaluate the contractor's notice and promptly advise the contractor of its determination on how to proceed in writing.

(3) (a) If the contracting unit determines that a change to the contractor's work caused or directed by the contracting unit materially changes the character of any aspect of the contract work, the contracting unit shall make a fair and equitable upward adjustment to the contract price and contract completion date. The basis for any such price adjustment shall be the difference between the cost of performance of the work as planned at the time of contracting and the actual cost of such work as a result of its change in character, or as otherwise mutually agreed upon by the contractor and the contracting unit prior to the contractor performing the subject work.

(b) If the contracting unit determines that the contractor is not entitled to additional compensation or time, the contractor shall continue the performance of all contract work, and shall be entitled to pursue a claim against the contracting unit for additional compensation or time attributable to the alleged material change.

(4) As used in this subsection, "material change" means a character change which increases or decreases the contractor's cost of performing the work, increases or decreases the amount of time by which the contractor completes the work in relation to the contractually required completion date, or both.

d. Change in Quantity Provisions:

(1) The contracting unit may increase or decrease the quantity of work to be performed by the contractor.

(2) (a) If the quantity of a pay item is cumulatively increased or decreased by 20 percent or less from the bid proposal quantity, the quantity change shall be considered a minor change in quantity.

(b) If the quantity of a pay item is increased or decreased by more than 20 percent from the bid proposal quantity, the quantity change shall be considered a major change in quantity.

(3) For any minor change in quantity, the contracting unit shall make payment for the quantity of the pay item performed at the bid price for the pay item.

(4) (a) For a major increase in quantity, the contracting unit or contractor may request to renegotiate the price for the quantity in excess of 120 percent of the bid proposal quantity. If a mutual agreement cannot be reached on a negotiated price for a major quantity increase, the contracting unit shall pay the actual costs plus an additional 10 percent for overhead and an additional 10 percent for profit, unless otherwise specified in the original bid.

(b) For a major decrease in quantity, the contracting unit or contractor may request to renegotiate the price for the quantity of work performed. If a mutual agreement cannot be reached on a negotiated price for a major quantity decrease, the contracting unit shall pay the actual costs plus an additional 10 percent for overhead and an additional 10 percent for profit, unless otherwise specified in the original bid; provided, however, that the contracting unit shall not make a payment in an amount that exceeds 80 percent of the value of the bid price multiplied by the bid proposal quantity.

(5) As used in this subsection, the term "bid proposal quantity" means the quantity indicated in the bid proposal less the quantities designated in the project plans as "if and where directed."

PREVAILING WAGE PAYMENT CERTIFICATION

This form must be executed by Contractor and submitted with final voucher prior to final payment.

PROJECT Public Works Building

TO City of Margate City
(NAME OF OWNER AS IT APPEARS IN CONTRACT)

RE: Contract for Certification of Contractor of Payment of Prevailing Wages to Workmen Pursuant to New Jersey Prevailing Wage Act. Chapter 150 Laws of 1963 of New Jersey and all other claims.

The undersigned Contractor hereby certifies that any and all workmen employed by the undersigned Contractor and all Subcontractors have been paid in full and prevailing wages for their respective crafts or trades as determined and computed by the Commissioner of Labor and Industry, of the State of New Jersey, and that all suppliers and material men have been paid in full all amounts claimed by them, and there remains no outstanding claim, lien, or dispute; nor any contingent claim by any of the foregoing:

DATED: _____ _____
CONTRACTOR

STATE OF NEW JERSEY

COUNTY OF _____

_____ , being duly sworn according to law, upon his oath disposes and says that he is the _____ (Owner-pres. or authorized agent) of _____ (name of corporation) that he has read the aforesaid statement of certification and knows the content thereof, and that the same is true of his own knowledge and this affidavit is being executed by him pursuant to the New Jersey Prevailing Wage Act (Chapter 150 of Laws of 1963).

_____
Signature

Sworn and subscribed to
before me this _____day of _____ 20____,

_____
Notary Public of New Jersey

CERTIFICATION OF SITE SAFETY CONDITIONS

Form GC-6.02S

TOWN: City of Margate City PROJECT NAME: Public Works Building

COUNTY: Atlantic JOB #: 0116U200

I hereby certify that site safety conditions and the means and methods of construction have been and are in accord with the provisions of the Contract Documents and all requirements contained and referenced therein since the last executed Certificate of Site Safety Conditions, except as noted:

☐ Unsafe Trench Condition ☐ Unsafe Entry to Live Manhole

☐ Unsafe Traffic Control ☐ Unsafe Equipment

☐ Inadequate Fall Protection ☐ Proximity to Electric

☐ Other _____

☐ None _____

Comments/Resolutions _____

Contractor: _____

by: _____
Authorized Representative

I executed this form at _____ on _____.
Time Date

FULL RELEASE AND WAIVER OF LIENS

WHEREAS**,** the undersigned is a subcontractor, supplier or other person furnishing work, services, materials or equipment upon real estate owned by the City of Margate City in the City of Margate City, State of New Jersey in furtherance of that certain Public Works Building sponsored by the City of Margate City (hereinafter referred to as "Owner").

Receipt is acknowledged of $ _____, which represents full payment, for work, services, materials and/or equipment furnished and installed by us at the above referenced project, the undersigned does hereby waive, release and relinquish the Owner and the Building/Land from any and all claims and/or construction liens pursuant to N.J.S.A. 2A:44A-1 *et seq.* relating to this Project, to the extent of $_____.

We agree to hold the Owner and the Building/Land harmless against any claim made or lien filed by any of our material suppliers and subcontractors who performed work or supplied materials for the Project to-date.

In addition, the undersigned warrants: (a) that any claims for payment for work, services, materials and/or equipment furnished in the construction or repair of the aforesaid real estate and improvements have not been assigned; (b) that all laborers, subcontractors and suppliers of the undersigned who have furnished work, services, materials and/or equipment in the construction or repair of the aforesaid real estate and improvements have been fully paid and that none of such laborers, subcontractors or suppliers have or will have any claim, demand or lien against the aforesaid real estate and improvements; and (c) that no financing statement, chattel mortgage, security interest, conditional bill of sale or retention of title agreement has been given or executed or will be given or executed for or in connection with any materials, appliances, machinery, fixtures or furnishings placed upon or installed, or to be placed upon or installed, in the aforesaid real estate and improvements by the undersigned.

IN WITNESS WHEREOF, the undersigned has executed and sealed this Full Release and Waiver of Liens this

_____ day of _____, 20.

Paid to date: $ _____

NAME OF SUBCONTRACTOR/SUPPLIER: _____

By: _____

Title: _____

Sworn and subscribed to

before me this _____ day of _____ 20____,

_____

Notary Public of New Jersey

Revised 9/22

TABLE OF CONTENTS

SECTION NO.	DESCRIPTION
--------	SCOPE OF WORK
010000	GENERAL REQUIREMENTS
01010	AS BUILT PLANS
013300	SUBMITTALS
017829	AS-BUILT PLANS AND GIS SYSTEM DATA REQUIREMENTS
018929	CLEANING AND RESTORATIONS
032000	CONCRETE REINFORCING
033000	CAST-IN-PLACE CONCRETE
036000	GROUTING
048100	UNIT MASONRY ASSEMBLIES
051200	STRUCTURAL STEEL FRAMING
052100	STEEL JOIST FRAMING
053100	STEEL DECKING
054000	COLD-FORMED METAL FRAMING
055000	METAL FABRICATIONS
055100	METAL STAIRS
055213	PIPE AND TUBE RAILINGS
061000	ROUGH CARPENTRY
061600	SHEATHING
062013	EXTERIOR FINISH CARPENTRY
062023	INTERIOR FINISH CARPENTRY
064013	EXTERIOR ARCHITECTURAL WOODWORK
064023	INTERIOR ARCHITECTURAL WOODWORK
064100	ARCHITECTURAL WOOD CASEWORK
071353	ELASTOMERIC SHEET WATERPROOFING
071416	COLD FLUID-APPLIED WATERPROOFING
072100	THERMAL INSULATION
072500	WEATHER BARRIERS
072600	VAPOR RETARDERS
072726	FLUID-APPLIED MEMBRANE AIR BARRIERS
074113.16	STANDING-SEAM METAL ROOF PANELS
074213.13	FORMED METAL WALL PANELS
075423	THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING
077100	ROOF SPECIALTIES
077200	ROOF ACCESSORIES
077253	SNOW GUARDS
078123	INTUMESCENT FIRE PROTECTION
078413	PENETRATION FIRESTOPPING
078443	JOINT FIRESTOPPING
079200	JOINT SEALANTS
079219	ACOUSTICAL JOINT SEALANTS
079513.13	INTERIOR EXPANSION JOINT COVER ASSEMBLIES
079513.16	EXTERIOR EXPANSION JOINT COVER ASSEMBLIES
081213	HOLLOW METAL FRAMES
081416	FLUSH WOOD DOORS
083113	ACCESS DOORS AND FRAMES
083323	OVERHEAD COILING DOORS

083613	SECTIONAL DOORS
084113	ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS
085113	ALUMINUM WINDOWS
087100	DOOR HARDWARE
088000	GLAZING
088813	FIRE-RATED GLAZING
089119	FIXED LOUVERS
092216	NON-STRUCTURAL METAL FRAMING
092900	GYPSUM BOARD
093013	CERAMIC TILING
093033	STONE TILING
095123	ACOUSTICAL TILE CEILINGS
096513	RESILIENT BASE AND ACCESSORIES
096519	RESILIENT TILE FLOORING
096723	RESINOUS FLOORING
096813	TILE CARPETING
097200	WALL COVERINGS
099113	EXTERIOR PAINTING
099123	INTERIOR PAINTING
099300	STAINING AND TRANSPARENT FINISHING
099600	HIGH-PERFORMANCE COATINGS
101100	VISUAL DISPLAY UNITS
101416	PLAQUES
101419	DIMENSIONAL LETTER SIGNAGE
101423.16	ROOM-IDENTIFICATION PANEL SIGNAGE
102113.19	PLASTIC TOILET COMPARTMENTS
102600	WALL AND DOOR PROTECTION
102800	TOILET, BATH, AND LAUNDRY ACCESSORIES
104413	FIRE PROTECTION CABINETS
104416	FIRE EXTINGUISHERS
105113	METAL LOCKERS
105129	PHENOLIC LOCKERS
107119	FLOOD BARRIERS
113013	RESIDENTIAL APPLIANCES
115213	PROJECTION SCREENS
122413	ROLLER WINDOW SHADES
123213	MANUFACTURED WOOD-VENEER-FACED CASEWORK
123661	SIMULATED STONE COUNTERTOPS
124813	ENTRANCE FLOOR MATS AND FRAMES
142113	ELECTRIC TRACTION FREIGHT ELEVATORS
142123.16	MACHINE ROOM-LESS ELECTRIC TRACTION PASSENGER ELEVATORS
210517	SLEEVES AND SLEEVE SEALS FOR FIR SUPPRESSION PIPING
210518	ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING
210548	VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT
211313	WET-PIPE SPRINKLER SYSTEMS
220500	COMMON WORK REQUIREMENTS FOR PLUMBING
220517	SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING
220518	ESCUTCHEONS FOR PLUMBING PIPING
220523	GENERAL-DUTY VALVES FOR PLUMBING PIPING

220529	HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
220548	VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
220553	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
220700	PLUMBING INSULATION
221116	DOMESTIC WATER PIPING
221119	DOMESTIC WATER PIPING SPECIALTIES
221316	SANITARY WASTE AND VENT PIPING
221319	SANITARY WASTE PIPING SPECIALTIES
331343	PACKAGED DUPLEX GRINDER PUMPS
224000	PLUMBING FIXTURES
230500	COMMON WORK REQUIREMENTS FOR HVAC
230513	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
230519	METERS AND GAUGES FOR HVAC PIPING
230523	GENERAL-DUTY VALVES FOR HVAC PIPING
230529	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
230548	VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT
230553	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
230593	TESTING, ADJUSTING AND BALANCING FOR HVAC
230700	HVAC INSULATION
230900	BUILDING AUTOMATION SYSTEM
230993	SEQUENCE OF OPERATIONS
231123	FACILITY NATURAL-GAS PIPING
232113	HYDRONIC PIPING
233113	METAL DUCTS
233300	AIR DUCT ACCESSORIES
233423	HVAC POWER VENTILATORS
233616	VARIABLE AIR VOLUME SINGLE DUCT TERMINAL UNITS
233713	DIFFUSERS, REGISTERS AND GRILLES
237413	MZVAV &SZVAV PACKAGED ROOFTOP AIR CONDITIONING UNITS
238127	DUCTLESS SPLIT SYSTEMS
238239	SEPARATED COMBUSTION INDOOR GAS UNIT HEATERS
238240	ELECTRIC CABINET AND UNIT HEATERS
260450	ELECTRICAL DEMOLITION & RENOVATION
260500	COMMON WORK RESULTS FOR ELECTRICAL – MATERIALS AND METHODS GENERAL
260519	CONDUCTORS AND CABLES
260526	GROUNDING AND BONDING
260529	HANGERS AND SUPPORTS
260533	RACEWAYS & BOXES
260543	UNDERGROUND DUCTS AND RACEWEAYS FOR ELECTRICAL SYSTEMS
260553	ELECTRICAL IDENTIFICATION
262200	LOW-VOLTAGE DRY TYPE DISTRIBUTION TRANSFORMERS
262416	PANELBOARDS & SWITCHBOARDS
262726	WIRING DEVICES
262813	FUSES
262816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS
263213	DIESEL GENERATOR SETS
263600	SERVICE ENTRANCE RATED AUTOMATIC TRANSFER SWITCHES

264313	SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS
265100	LED INTERIOR LIGHTING
265600	LED EXTERIOR LIGHTING
271323	COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING
312100	EARTH MOVING FOR BUILDINGS AND STRUCTURES
312319	DEWATERING
312333	UTILITY EXCAVATION AND BACKFILL
315000	EXCAVATION SUPPORT AND PROTECTION
316223	CONCRETE FILLED STEEL PIPE PILES
323113	PVC COATED CHAIN LINK FENCE AND SWING GATES
328400	AUTOMATIC IRRIGATION SYSTEM
330519	DUCTILE IRON CULVERT PIPE
330531.12	POLYVINYL CHLORIDE GRAVITY SEWER PIPE HOUSE CONNECTIONS
330531.16	PVC WATER DISTRIBUTION MAIN
330533.13	CORRUGATED-WALL, SMOOTH INTERIOR HDPE GRAVITY PIPE
331153	MONITORING WELL
331413	DUCTILE IRON WATER MAIN AND FITTINGS
331417	WATER SERVICE LINE - COPPER
331419	WATER MAIN VALVES & PIPING APPURTENANCES
-------	SPECIAL PROVISIONS TO THE 2019 STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION

APPENDIX A N.J.D.E.P. ASPHALT MILLINGS GUIDANCE DOCUMENT

APPENDIX B GEOTECHNICAL INVESTIGATION REPORT

APPENDIX C ORDINANCE 08-2025

APPENDIX D PROJECT LABOR AGREEMENT

APPENDIX E SOIL CONSERVATION DISTRICT PERMIT

END OF TOC

SCOPE OF WORK

1.01 PROJECT SUMMARY

In general, this project consists of the construction of a New Public Works Building to be located on Block 324.01, Lot 125 in Margate City, Atlantic County, New Jersey. The proposed facility includes a building with a ground floor of 6,731 square feet and a second floor of 5,947 square feet associated site improvements and improvements in the Monmouth Avenue right-of-way. The existing public works facility on the site will remain in operation during construction located on Lot 2.01. This project includes all architectural, structural, civil/site, mechanical, electrical, plumbing, and fire protection systems complete in order to provide a turnkey facility for immediate use and occupation by the Margate City Public Works Department.

The allowable on-site area for use by the contractor during construction is shown on the Demo Plan Sheet 7 of 16. The contractor will be required to provide access throughout the project to the on-site fueling facility to City vehicles.

The above scope of work outlines the general items and distribution of work and shall not be construed as being all inclusive. The plans entitled "Margate Public Works Building–in the City of Margate City, Atlantic County, New Jersey, are appended hereto and are made part of these specifications.

1.02 NON-MANDATORY PRE-BID MEETING

A non-mandatory pre-bid meeting will be held at the Margate City Municipal Building, 9001 Winchester Avenue, Margate, New Jersey 08402 on Thursday, July 23, 2026 beginning at 10:00 a.m. prevailing time. It is recommended that all prospective bidders visit the site prior to bidding and ascertain for themselves the project conditions and include all costs for a complete job within the various related bid items outlined in the Proposal. The Owner is not responsible for additional costs based on the Contractor's failure to properly inspect the existing conditions.

1.03 QUESTIONS AND ANSWERS

Bidders are required to submit all questions in writing to the attention of Joseph Johnston of Remington & Vernick Engineers at EHToffice@rve.com, no later than 5:00 p.m. on Wednesday July 29, 2026. Answers will be issued to all bidders in accordance with New Jersey Local Public Contracts Law requirements.

1.04 PROJECT LABOR AGREEMENT

This project is being governed by the Project Labor Agreement provided in Appendix D. Each bidder is fully responsible for having reviewed and understood all requirements set forth in the Project Labor Agreement prior to submitting a bid, and shall not at any time thereafter assert any claim related to any misunderstanding of the nature of these requirements. In the case of any discrepancies among the requirements of the Project Labor Agreement and the various other requirements set forth in these bid documents, the more stringent requirement shall apply. All contractors and subcontractors will be required to provide

the Schedule C "Contractors Letters of Assent" contained in Appendix D of the specifications of the PLA as a condition of any contract award.

1.05 BIDS

The project consists of a base bid and an add alternate bid.

The base bid will contain all work shown on the plans and indicated in the specifications with the exception of the freight elevator. The add alternate bid shall be for the freight elevator and associated work for the installation of the freight elevator.

The award of the base bid and the add alternate bid will be based upon funds available for the project. It is the preference of the City to award the base bid and the add alternate.

1.06 GENERAL INFORMATION

The site will need to function as a Public Works Facility during construction. All existing operations on site will need to continue to function during construction including vehicle fueling. Limited area on-site is available for material storage. Additional material storage may be permitted on the municipal parking lot on Block 425, Lots 128, 130, p/0132 from October thru April contingent on the approval of the City.

Nightime operations shall not be permitted. Work on weekends shall not be permitted, unless approved by the City.

The contractor shall abide by the High Voltage Proximity Act when working in the vicinity of electric lines.

The contractor is advised that in accordance with technical specification section 312319 Dewatering the following will be required: "If the contractor utilizes a well point system for dewatering, a signed and sealed well point system design, prepared by a professional engineer licensed in the State of New Jersey, shall be provided by the contractor as part of the submittal process."

The contractor is advised that in accordance with technical specification section technical specification section 017829 As-Built Plans and Geographic Information System Data Requirements one of the requirements is as follows: "Subsurface features will have surveyed locations acquired before backfill."

Contractors will need to abide by the requirements contained in Margate City Ordinance No. 08-2025, a copy of which is contained in Appendix C.

At the end of each work day the streets shall be passable and open to traffic with access to driveways and all water services and sanitary sewer services shall be operational. Accommodations for emergency service vehicles shall be made at all times.

At the end of each work week (Friday) each street shall be left free of equipment and materials and normal traffic operations shall be permitted with access to driveways. Therefore, the contractor shall schedule material delivery, removal and equipment accordingly.

The City will not permit the storage of materials within the City. Therefore, the contractor will need to arrange for material storage at their property or at leased property outside of the City. The contractor will need to schedule material deliveries and removals accordingly.

The contractor shall be responsible to remove excess unwanted materials from the project site and dispose of all excess unwanted materials in accordance with all applicable laws and regulations.

All manhole castings shall be set to the base paving elevation and shall be reset to the finished paving elevation a maximum of two days prior to the surface course paving.

Separate payment will not be made for resetting castings that have been set to the base course elevation which are then reset to the final paving grade.

Sidewalk areas which are removed shall be maintained in a passable condition at all times. A sidewalk detour plan and detour will be required for the duration of the project. Driveways adjacent to sidewalk areas shall remain open.

Separate payment will not be made for Performance Bonds, Labor and Material Payment Bonds, Maintenance Bonds or for any insurance the contractor is required to have for the project.

The contractor shall be responsible for all construction layout. No separate payment will be made for this work.

The contractor shall obtain all utility markouts, verify the locations of all utilities both horizontally and vertically prior to the start of construction and notify the engineer of any conflicts. The contractor is strongly advised to dig the necessary test pits to make such determinations. No separate payment will be made for the test pits. The contractor shall also be responsible for coordinating all utility relocations that may be necessary. There will be no separate payment for this work.

Separate payment will not be made for sawcutting, trench bedding for pipe, elevational adjustments of cleanouts, gas valve boxes, water meter pits, water service valves, sprinkler heads, sprinkler lines, sprinkler valves and valve boxes, conductors or conduits damaged during construction or sod used for restorations. Sod shall be required to be installed in all work areas between the curb and sidewalk, where grass exists, and behind the sidewalk where disturbance has occurred to grass areas. These areas are considered areas of restoration and separate payment will not be made for this work.

Separate payment will not be made for pipe excavation and backfill required for the project.

It is the contractor’s responsibility to verify all pipe sizes, inverts and locations for the purpose of making the necessary connections between existing and proposed pipes and drainage structures. The contractor is strongly advised to dig the necessary test pits to make such determinations. Separate payment will not be made for the connections of existing pipes to proposed pipes, existing pipes to proposed manholes or inlets or proposed pipes to existing manholes or inlets

Prior to the start of construction, at a minimum of seven days, the contractor will be required to submit cut sheets indicating the proposed top and bottom of curb elevations.

The suitable hard material for the temporary trench finish specified in Section 312333 shall be bituminous concrete cold patch. At the end of each work day the temporary trench finish of bituminous cold patch shall be installed. The contractor shall be responsible for maintaining the cold patch surface to allow for smooth riding of vehicles on the surface. All determinations as to the smoothness of the rideability on the cold patch surface shall be made by the City.

The construction of the hot mix asphalt base course shall be performed within seven days after all utility work and concrete work has been completed. Final paving shall be performed at a minimum of thirty days after the hot mix asphalt base course has been placed in order to allow for trench settlement on streets where utility work has occurred.

The contractor is responsible for providing temporary sanitary facilities for the project. The contractor shall site all temporary sanitary facilities in such a manner to have the least amount of impact on City residents. The contractor shall be required to relocate any temporary sanitary facilities at the direction of the Engineer. Relocations shall occur within one (1) hour of notification by the Engineer. Separate payment will not be made for temporary sanitary facilities or any relocations.

Prior to the start of construction, at a minimum of seven days, the contractor will be required to submit cut sheets indicating the proposed top and bottom of curb elevations. As part of the cut sheet submittal process existing elevations of the curb gutter and drainage structures and the tie in points shall be provided. Separate payment will not be made for cut sheets.

The Contractor shall not be allowed to work after sundown on September 11, 2026, during the day of September 12, 2026 after sundown on September 20, 2026 and during the day of September 21, 2026 unless otherwise directed by the City.

Uniformed law enforcement officers are not required for the project. Maintenance and protection of traffic will be by the contractor.

The Contractor shall designate a Traffic Control Coordinator for the project that can be reached 24 hours a day, seven days a week. The Traffic Control Coordinator shall coordinate all traffic control with the Margate City Chief of Police and Engineer. Separate payment will not be made for the Traffic Control Coordinator or for traffic control coordination.

All bidders shall visit the site prior to bidding and ascertain for themselves the existing conditions, determine the difficulties which will be encountered for a complete job, and include all costs within the various related bid items outlined in this proposal.

The Contractor is responsible for coordinating the work of all other contractors on the project. Any costs related to this coordination shall be included in the various pay items of the project.

Quantities shown on the drawings are for the convenience of the contractor only. Items will be paid on a lump sum basis and no additional payment will be made if as-built quantities exceed plan quantities.

Only major items of work are given in the Bid Form, but it is the intent of the specifications to secure a completely interconnected and functioning system, and if any workmanship or materials be required which are obviously necessary to carry out the full intent and meaning of the plans and specifications or to be reasonably inferred therefrom, the cost of such workmanship or materials shall be included in the price bid for the major items of work.

For the purpose of preparing progress schedules and estimates for payments to the Contractor, the work to be performed under this Contract has been divided into lump sum items. The contractor is responsible and obligated to successfully complete the entire project and to complete each and every necessary detail of each and every item specified and/or shown on the contract drawings regardless of whether or not a particular detail is specifically mentioned. Any detail of work called out on the drawings but not called out in the specifications, or any item of work or detail not called out on the drawings but called out in the specifications, shall be considered the same as if it was called out in both the specifications and the drawings.

The contractor is responsible for coordinating with and paying for all required testing on the project.

The contractor is responsible for obtaining all permits associated with the project. The contractor will also be responsible for the payment of all building permit fees.

The City of Margate reserves the right to reject or award any or all bids, either in whole or in part, whichever is in the best interest of the City.

The plans entitled “New Public Works Building”, City of Margate City, Atlantic County, New Jersey” are appended hereto and are part of these specifications.

END OF SCOPE OF WORK

SECTION 010000
GENERAL REQUIREMENTS

1.01 GENERAL

A. Only major items of work are given in the Bid Form, but it is the intent of the specifications to secure a completely interconnected and functionable system, and if any workmanship or materials be required which are obviously necessary to carry out the full intent and meaning of the plans and specifications or to be reasonably inferred therefrom, the cost of such workmanship or materials shall be included in the unit price for the major items of work.

B. Where construction is being performed in traveled roadways, Contractor is to provide necessary traffic control and devices in accordance with the Current Manual on Uniform Control Devices.

C. Contractor shall notify all utility companies prior to construction of the work under this contract including the utility "Call Before You Dig" requirement at 1-800-272-1000 for any excavation or asphalt paving work under the contract.

D. Prior to any excavation, the Contractor shall have all utilities marked, and shall excavate or otherwise determine the exact location and elevations of said utilities. The Contractor shall notify the Engineer of any conflicts. The Contractor shall arrange for any necessary utility relocations or plan changes and shall reschedule his operations appropriately.

E. The contractor, in the construction of any project, shall not stockpile materials or his equipment on any private property; except areas designated by the plans or as directed by the Engineer. If so required, the Engineer may direct the Contractor to have his equipment removed from any project during weekend hours.

F. All work of refilling sunken ditches, repaving over trenches and keeping streets and sidewalks in passable condition shall be done to the satisfaction of the owner during the construction of the above work as well as during the maintenance period. If any work is not done within five (5) days after written notice is given by the Engineer, the work may be done by the Owner and charged to the Contractor.

G. Special care shall be taken to prevent contamination, siltation, or interfering in any way with the stream flows or ponds along the line of work. No waste matter of any kind will be allowed to discharge into the stream flows or impounded water or any ponds or other bodies of water.

H. The contractor is hereby advised that N.J.S.A. 4:24-39 et seq., Soil Erosion and Sediment Control Act is applicable to this project.

I. It is the intent of the current standards for Soil Erosion and Sediment Control to insure that proper measures for erosion control are employed and provide for the early establishment of vegetation that will help avoid erosion problems during and after construction. It is expected that the contractor will anticipate possible problems and provide timely and adequate control to prevent or minimize adverse effect.

J. The contractor shall apply and pay for all permits that may be required for any of the work involved with this project. Municipalities or Authorities having an interest or jurisdiction on this project are: ***City of Margate City.***

K. Contractor is to notify residents by door-hangers at least forty-eight (48) hours in advance before starting construction work.

L. All notes on plans shall be made a part of the specifications.

M. Contractor shall notify Engineer at least forty-eight (48) hours in advance of any work on Saturdays. There will be no work permitted on Sundays or holidays. This project will receive inspections and the normal working hours for the Inspector are from 8:00 AM to 4:30 PM, Monday through Friday. Any overtime inspection costs which are avoidable will be reimbursed by the contractor.

N. During the construction of the project, travel lanes shall remain open at all times.

O. Contractor shall take extreme care in the placement of the asphaltic tack coat so as to not make it visible on the concrete curb. It shall be the contractor's responsibility to keep the concrete curb clean of this oil.

1.02 PUBLIC UTILITIES

A. The bidder is advised to ascertain for himself all the facts concerning the location of existing utilities.

B. The contractor shall cooperate with the utility owners in the adjustment of their facilities and shall notify the utility owners not less then ten (10) days in advance of the time he proposes to perform any work that will endanger or affect their facilities.

C. The Contractor shall permit the owners of utilities, or their agents access to the site of the work at all times in order to relocate, construct or protect their lines and he shall cooperate with them in performing this work.

D. Separate payments will not be made for the coordination and cooperation of the contractor with the utility companies, nor for the protection or replacement of utilities as specified hereinbefore and the bidder shall include all such costs in the prices bid for the various scheduled items in the Bid Form.

1.03 PRE-CONSTRUCTION PHOTOGRAPHS

A. The Contractor shall, at no extra cost, take DVD or digital photographs of the site prior to the commencement of construction. The DVD or photograph record shall accurately depict the existing preconstruction condition of all curbs, sidewalks, driveways, fences, lawns, landscaped areas, mailboxes, street furniture and all other appurtenances within, or outside a 25 foot radius of the limits of the construction of the project. One (1) copy of the CD photograph record or DVD shall be provided to the Engineer. The date of all disks, as well as identification as to the location which the records depict, must be provided.

1.04 MAINTENANCE & PROTECTION OF TRAFFIC

A. The contractor shall erect or place and maintain in good condition, barricades, warning signs, lights, rubber traffic cones, and other warning and danger signals and devices, appropriate and adequate for the specific needs and subject to the Engineer's approval at working sites, closed

roads, intersections, open excavations, locations of material storage, standing equipment and other obstructions, at points where the usable traffic width of the road is reduced, and at points where traffic is deflected from it's vehicular or pedestrian traffic.

B. The contractor shall provide sufficient watchmen and traffic directors and shall take all other precautions including any that may be ordered by the Engineer, which are necessary for the safety of the public and protection of the work.

C. The contractor shall obtain the approval and consent of all appropriate authorities having jurisdiction, for any detours which may be required. The contractor shall make all necessary arrangements with such authorities regarding the establishment, maintenance and repair of such detours, the regulations and direction of traffic thereon, and the installation and maintenance of sign and traffic devices.

D. Before beginning work on any phase of the project, the contractor shall furnish and install all specified warning signals, barricades, wood traffic guides, lights and other devices necessary, in the opinion of the Engineer, to protect the public during that phase of his operations.

E. Road construction signs shall be placed at each end of the project along the road for the work along the public road.

F. During the work on this project, the contractor shall provide and/or be prepared to provide traffic protection devices in accordance with Part VI "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS.", Current Edition. The minimum numbers set forth in the Manual shall be on hand at each separate project site prior to the commencement of any work (or phase of work) and shall be maintained available on the project site throughout the period of the project (or phase). Failure to provide and maintain the minimum number of devices specified in the Manual shall be sufficient cause for the Engineer to order cessation of the work. When lack of any required safety devices presents an immediate hazard, the engineer may order that such devices be provided by the Owner or by other contractors, deducting the cost thereof from any monies due or becoming due the contractor.

G. Additional devices up to the maximum number set forth in the Manual shall be provided by the contractor as required or directed prior to the commencement of any operation or phase of an operation requiring such devices.

H. Traffic directors (flagmen) shall be provided whenever alternate two-way traffic is maintained in a single lane, whenever contractor's operations require closing of a lane or portion of a lane on a multiple lane roadway, whenever the contractor's equipment or vehicles are entering or leaving active roadways at other than normal street intersections, whenever a contractor's operations will be contrary to or cause confusion regarding normal traffic control devices (traffic signals, signs, etc.) within a work area and whenever else, in the opinion of the Engineer, the contractor's operations cause such hazards as to require the use of Traffic Directors.

I. Traffic Directors must meet MUTCD qualifications and shall be responsible and thoroughly familiar with their responsibilities, and while serving as Traffic Directors, shall not be required to perform any other duties. Traffic Directors shall be provided with a STOP/SLOW paddle and wear 360 degree high-visibility retroreflective orange safety garment meeting ANSI/ISEA Class 3, Level 2 standards and appropriate head gear where required.

J. Traffic must be maintained throughout each separate work area during construction. At least one 12' lane must be maintained for traffic during all actual construction periods and at least two 10' lanes must be maintained for traffic at all other times.

K. The contractor is advised that there is heavy commuter traffic during the morning from 7:30 AM to 9:00 AM and the afternoon from 4:00 PM to 5:30 PM. The contractor shall schedule his construction activity such that he does not interfere or restrict traffic during the above peak hours.

L. Construction shall be so staged to maintain at least one lane for traffic in each direction throughout each separate work area during the morning, 7:30 AM to 9:00 AM, and the afternoon, 2:30 PM to 5:30 PM weekday periods of peak traffic.

M. Any restriction of traffic at any time shall be subject to the review of the Engineer and the Police Department having jurisdiction in the work area. The contractor shall submit a schedule of staged construction for review prior to any restriction of traffic.

N. If detours are proposed by the Contractor, they are to be submitted to the Engineer for review and approval by the Police Department having jurisdiction in the work area and any other agency having jurisdiction of the roadway that will be detoured or roadway that will be used as a detour.

O. All detour signs shall conform to the requirements for Traffic Control Devices.

P. Temporary traffic stripes will be necessary to control and guide traffic through individual work areas. The contractor shall submit a scheme for review by the Engineer of all temporary traffic stripes prior to removal of any existing traffic stripes.

Q. Construction of proposed utilities across existing roadways shall be so staged to maintain one lane in each direction. Trenches shall not remain open overnight.

R. The contractor shall provide adequate means of access for fire, police and emergency vehicles throughout the length of the project.

1.05 TEMPORARY PAVING FOR ALL TRENCHES

A. Description - 2" thick temporary paving shall be in accordance with the plans and specifications and to the prescribed lines and grades. Temporary paving replacement shall include necessary excavation. Temporary paving shall be placed at the end of each working day to the adjacent street grade

B. Materials - Materials shall conform to the New Jersey Department of Transportation Standard Specifications for Road and Bridge Construction 2019 and/or as amended by these contract specifications (Section 901.05 Aggregates for HMA).

C. Contractor shall submit to Engineer, in triplicate, reports on materials used, attesting to the fact that said materials conform with these specifications of the State of New Jersey Department of Transportation and the Engineer.

D. Method of Construction - Unless shown or specified otherwise, the trenches or other excavation, after backfilling, shall be covered with 2" Thick temporary paving to the adjacent street grade in passable condition suitable for normal use.

1.06 REFERENCE TO THE STANDARD SPECIFICATIONS

A. Portions of the work performed under this contract shall comply with the requirements of the State of New Jersey Department of Transportation Standard Specifications for Road and Bridge Construction 2019, as amended or supplemented by these specifications are made a part of these specifications. The New Jersey Department of Transportation Standard Construction Details shall govern except insofar as same are modified, amended or changed in detail drawings prepared specifically for this particular project.

B. The Standard Specifications are made part of these specifications by this reference as if they were set forth in full. It is the responsibility of the prospective bidder to be familiar with these Standard Specifications. Copies may be examined in the Engineer's office or may be obtained from the New Jersey Department of Transportation, 1035 Parkway Avenue, Trenton, New Jersey, 08625.

1.07 DUST CONTROL

The contractor will be required to maintain all excavations, embankments, stockpiles, haul roads, permanent access roads, plant sites, waste areas, borrow areas, and all other work areas within or outside the project boundaries free from dust which would cause a hazard or nuisance to others. Approved temporary methods of stabilization consisting of sprinkling, chemical treatment, light bituminous treatment or similar methods will be permitted to control dust. Sprinkling, to be approved, must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times, and the contractor must have sufficient competent equipment on the job to accomplish this if sprinkling is used. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs. If any dust control is not done within twenty-four (24) hours after written notice is given by the Engineer, the work may be done by the Owner and charged to the Contractor. Costs for dust control shall be included in the prices bid for the various items in the bid form.

END OF SECTION

SECTION 013300

SUBMITTALS

SECTION 1 – GENERAL

1.01 Summary: This section specifies requirements for handling submittals.

1.02 General Procedures: Coordinate submittal preparation with performance of construction activities, and with purchasing or fabrication, delivery, other submittals and related activities. Transmit in advance of performance of related activities to avoid delays.

Coordinate transmittal of different submittals for related elements so processing will not be delayed for coordination with other submittals. The Engineer reserves the right to withhold action on a submittal requiring coordination until related submittals are received.

Processing: Allow two weeks for review. Allow more time if processing must be delayed for coordination with other submittals. The Engineer will advise the Contractor when a submittal must be delayed for coordination. Allow two weeks for reprocessing each submittal.

No extension of time will be authorized because of failure to transmit submittals sufficiently in advance of the Work to Permit processing.

Submittal Preparation: Place a label or title block on each submittal for identification. Provide a 4" x 5" space on the label or beside the title block on shop drawings to record Contractor's review and approval markings and action taken. Include the following information on the label for processing and recording action taken:

Project Name
Date
Name and address of Engineer
Name and address of Subcontractor
Name and address of Supplier
Name of Manufacturer

1.03 Submittal Transmittal: Package submittals appropriately for transmittal and handling. Transmit with a transmittal form. Submittals received from other than the Contractor will be returned without action.

1.04 Contractor's Construction Schedule: Submit a fully developed, bar-chart type construction schedule at the pre-construction conference. Provide a separate bar for each construction activity and a vertical line to identify the first working day of each week.

Coordinate the construction schedule with the list of subcontracts, submittal schedule, progress reports, payment requests and other schedules.

Indicate completion in advance of the date established for substantial completion. Indicate substantial completion on the schedule to allow time for the Engineer's procedures necessary for certification of substantial completion.

1.05 Distribution of Schedules: Distribute approved copies of the construction schedules to the Engineer, Owner, Subcontractors, and other parties required to comply with scheduled dates. Post copies in the temporary field office. When revisions are made, distribute to the same parties and post in the same locations.

Updating: Revise each schedule after each meeting or activity, where revisions have been made. Issue the updated schedules concurrently with report of each meeting. The revised schedule must be approved by the engineer.

1.06 Daily Construction Reports: Prepare a daily construction report, recording information concerning events at the site. Submit duplicate copies to the Engineer at weekly intervals. Include the following information:

List of subcontractors at the site.
High and low temperatures, general weather conditions.
Accidents, stoppages, delays, shortages, losses.
Emergency procedures.
Change orders received, implemented.
Partial completions, occupancies.
Substantial completions authorized.

1.07 Shop Drawing: Submit new information, drawn to accurate scale. Indicate deviations from contract documents. Do not reproduce contract documents or copy standard information as the basis of shop drawings. Include the following information:

Dimensions
Identification of products and materials included.
Notation of coordination requirements.
Notation of dimensions established by field measurement.

Sheet Size: Except for templates, patterns and similar full-size drawings, submit shop drawings on sheets at least 8 1/2" x 11" but no larger than 30" x 42".

Do not use shop drawings without a final stamp indicating action taken indicating action taken in connection with construction.

1.08 Product Data: Collect product data into a single submittal for each element or system. Mark each copy to show applicable choices and options. Where product data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information:

Manufacturer's printed recommendations.
Compliance with recognized trade association standards.
Compliance with recognized testing agency standards.
Application of testing agency labels and seals.

Notation of dimensions verified by filed measurement.
Notation of coordination requirements.

Submittals: Submit eight (8) copies of each required paper submittal. The Engineer will retain six (6) copies and return the others marked with action taken and corrections or modifications required. Alternatively, one (1) electronic pdf type file may be submitted on disc or via e-mail. Reviewed submittals may be transmitted as paper copies, e-mail copies or electronic copies on disc at the sole discretion of the Engineer.

Unless noncompliance with contract document provisions is observed, the submittal may serve as the final submittal.

Distribution: Furnish copies of final submittal to installers, and other required for performance of construction activities. Show distribution on transmittal forms. Do not proceed with installation until an applicable copy of product data is in the installer's possession. Do not permit use of unmarked copies of product and data in connection with construction.

1.09 Samples: Submit full-size samples cured and finished as specified and identical to the product proposed. Mount, display or package samples to facilitate review. Prepare samples to match the Engineer's sample. Include the following:

1. Generic Description
2. Compliance with Recognized Standards
3. Source Availability and Delivery Time
4. Product name or name of manufacturer

Submit samples for review of kind, color, pattern and texture for a final check of these characteristics and a comparison of these characteristics between the final submittal and the component as delivered and installed. Where variations are inherent in the product, submit multiple units that show limits of the variations.

Refer to other sections for samples that illustrate details of assembly, fabrication techniques, workmanship, connections, operation and similar characteristics.

Refer to other sections for samples to be returned for incorporation in the work. Such samples must be undamaged at the time of use. On the transmittal indicate special requests regarding disposition of sample submittals.

Submittals: Except for samples illustrating assembly details, workmanship, fabrication techniques, connections, operation and similar characteristics, submit three (3) sets; one will be returned marked with the action taken. Maintain sample sets at the project site for quality comparisons.

Unless noncompliance with contract document provisions is observed, the submittal may serve as the final submittal.

Sample sets may be used to obtain final acceptance of the construction associated with each set.

1.10 Distribution: Prepare additional sets for subcontractors, manufacturers, fabricators, installers, and others as required for performance. Show distribution on transmittal forms.

1.11 Engineer's Action: Except for submittals for record, information or similar purposes, where action and return is required, the Engineer will review each submittal, mark to indicate action taken and return. Compliance with specified characteristics is the contractor's responsibility.

Action Stamp: The Engineer will stamp each submittal with a self explanatory action stamp. The stamp will be appropriately marked to indicate action taken.

SECTION 2 – MATERIALS

A. Not Applicable

SECTION 3 – EXECUTION

A. Not Applicable

END OF SECTION

SECTION 017829

AS-BUILT PLANS AND GEOGRAPHIC INFORMATION SYSTEM DATA REQUIREMENTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The Contract Documents, including the Project Technical Requirements (Scope of Work and Technical Specifications) apply to this Section.

1.2 SUMMARY

A. Section includes requirements for Contractor to collect, document and provide accurate and complete spatial data, in formats compatible with GIS as defined, for all features being designed and constructed as part of Project.

B. Section includes requirements for the Contractor to provide reproducible as-built plans for the project.

1.3 SUBMITTALS

A. Provide complete and final GIS datasets upon completion of the construction.

B. Upon receipt of a data deliverable, the Owner will perform a data review which may include but not be limited to verification of spatial accuracy, attribute data accuracy, a check for omissions, duplications, inconsistencies, validation of geometry, and review of the topological relationships between features in the data deliverable. Any errors in spatial location (within the specified spatial accuracy) or attribute value will result in that feature being identified as being in error. If the features of any single feature class within a data deliverable do not meet the 99% confidence level, the complete data deliverable will be rejected.

C. Content of resubmitted data deliverables shall not change except to address the deficiencies identified. New features shall not be added to resubmitted data deliverables except as required to resolve deficiencies.

D. Provide a set of reproducible as-built plans upon completion of construction and prior to final payment.

1.4 QUALITY CONTROL AND QUALITY ASSURANCE

A. Contractor shall define quality control and quality assurance procedures to be employed in the development and review of GIS data. The GIS data provided by the Contractor is expected to be error free. Contractor data review processes shall follow quality assurance procedures and standards as specified in *ISO/DIS 19157 Geographic Information - Quality Evaluation Procedures (ISO9000).*
All GIS data shall be created, captured and delivered in accordance with the New Jersey Department of Environmental Protection Geographic Information System Mapping and Digital Data Standards, dated October 2013 and the New Jersey Environmental Protection Bureau of Geographic information Systems, Office of Information Resource Management GPS Data Collection Standards for GIS Data Development, dated April 24, 2017.

PART 2 - PRODUCTS.

2.1 DELIVERABLE FORMAT

A. All GIS data deliverables will be provided on CD, DVD disk or Flash Drive. If the deliverable is too large to fit on to a single CD, DVD or Flash Drive, an alternative, compatible delivery media shall be provided by Contractor. Each disk will be clearly labeled with the project name and the date of the delivery. Contractor shall provide five (5) copies of each deliverable.

B. The disks will be readable by personal computer running the latest version of the Microsoft Windows operating system.

C. All data will be delivered in its native file format, and must include the associated Info directory

D. Each disk will contain a folder named "Geodatabase _SP" and it will contain a single geodatabase as described in this Section. The geodatabase will be compatible with the most recent production release (not beta-release) of ArcGIS.

E. To facilitate logging and tracking of deliverable review, a text file will be provided in the root folder of the disk. The contents of this text file will include the following:

1. Original Delivery Date: <date when version 1 of this deliverable was submitted>.
2. Deliverable Title: <contractor specified title that remains constant for all revisions>.
3. Deliverable Number: <Sequential delivery number>.<Revision number>.
4. Contact Person: <Name, phone, e-mail>.

F. As-built plans shall be a reproducible of the original contract plans including any additional sheets required. All deviations from the original contract plans shall be on the as-builts. The plans shall be legible, neat, and of a quality acceptable to the Engineer. The Engineer shall provide a set of reproducibles at the beginning of the project.

2.2 DELIVERABLE CONTENT

A. GIS features will be delivered with coordinates that match the actual, as-built conditions. The distance between two points on the ground shall equal the distance shown in the drawing or feature class. All subsurface (underground) features shall be depicted as if they were on the surface. All valves, water services, sanitary sewer services, water mains, sanitary sewer mains, storm sewer mains sanitary sewer force mains, manholes, inlets, junction boxes fire hydrants, bends, crosses and meter boxes shall be as-built.

B. GIS data shall be provided as follows:

1. The dataset shall be provided in the New Jersey State Plane coordinate system. This dataset shall be provided in geodatabase format and placed in the "Geodatabase_SP" folder described above. It shall meet the following requirements:

   a. Coordinates shall be recorded in decimal US survey feet.
   b. Horizontal coordinates shall be based on the North American Datum of 1983 (NAD83) and the Geographic Reference System (GRS 80) ellipsoid.

2. All vertical measurements for the above GIS datasets shall be recorded based on "North American Vertical Datum of 1988 (NAVD 88)" and measured in feet above datum.

C. Spatial coordinates shall be accurate to within 1 meter horizontally.

D. Subsurface features will have surveyed locations acquired before backfill.

2.3 GEOMETRY

A. Complex geometry types (e.g. true curves, donuts, etc.) will be converted to simple geometry so that the delivered data meet the spatial accuracy described above. Contractor shall notify Owner if it is not possible to accurately represent the feature using simple geometry types.

B. The features shall be represented by valid geometry.

2.4 GEODATABASE STRUCTURE

A. The geodatabase shall contain a single feature dataset. All feature classes will be contained within a single feature dataset, appropriate to the feature class functional type.

2.6 METADATA

A. Each feature class in a submittal will include complete metadata that follows the "Content Standard for Digital Geospatial Metadata (CSDGM), Vers.2 (FGDC-STD-001-1998)." Metadata will be validated as part of Contractor's Quality Control procedure.

PART 3 - EXECUTION

3.1 SUBMITTAL SCHEDULE

A. Contractor shall provide deliverables as described below.

1. As-Built Plans – Prior to close out of the project, Contractor shall provide the reproducible as-built plans. The As-Built reproducible plan deliverable shall be accepted by the owner as a prerequisite for final payment.
2. As-Built GIS Data - Prior to close out of the project, Contractor shall provide a GIS data deliverable that contains as-built data for features constructed in the project. This As-Built GIS Data deliverable shall be accepted by the Owner as a prerequisite for final payment.

B. If a feature is modified, or somehow altered in a way that affects the spatial or attribute data after GIS data have been submitted, a revised GIS feature description will be submitted within 30 days of the revision.

C. If a feature that has already been described in a GIS submittal is removed, an additional submittal will be made within 30 days of its removal.

3.2 DATA OWNERSHIP

A. All data submitted during this project becomes the property of the Owner upon initial submission.

B. The Contractor shall not distribute any of the GIS data, or any draft data that contributed to the final GIS datasets, without written approval from the City of Margate.

3.3 AS- BUILT PLANS

A. The contractor shall be responsible for keeping the as-built up-to-date as the project progresses.

B. Water Services and Sanitary Sewer Services: Services shall be indicated by means of triangulation off of the front of the building. If no building exists, then by two permanent features.

C. Water Mains, Sanitary Sewer mains, Storm Sewer Mains, and Force Mains: Actual distance installed, actual inverts at each structure and bend, and high and low points. At each fitting, bend and gate valve, tie dimensions shall be provided to three permanent features.

D. Sanitary and Storm Sewer Structures: Actual location, Rim, grate and all invert elevations.

E. This section is intended to provide a minimum level of acceptance. Any section with more stringent requirements shall have precedence over this section.

END OF SECTION

SECTION 018929

CLEANING AND RESTORATIONS

SECTION 1 – GENERAL

1.01 DESCRIPTION

A. Contractor shall provide all equipment, labor & materials required to clean and restore the site to at least the existing condition.

B. Maintain premises and public properties free from accumulations of waste, debris and rubbish caused by work operations.

C. At completion of work, remove waste materials, rubbish, tools, equipment, machinery and surplus materials; clean all sight exposed surfaces; leave project clean and ready for occupancy.

D. At completion of work, restore or replace, when and as directed by the Engineer, any public or private property disturbed or damaged by Contractor's work operations to a condition at least equal to that existing prior to beginning work, or as otherwise specified. Materials, equipment and methods shall be approved by the Engineer.

SECTION 2 - MATERIALS

2.01 MATERIALS

A. For restorations, use the following materials. All materials shall comply with the following Articles of the New Jersey Department of Transportation Standard Specifications 2007 Edition and these specifications.

B. Grass restorations: See Section 808 “Sodding”.

C. Pavement restorations: See Section 401 Hot Mix Asphalt (HMA) courses.

D. Restoration of curbs and other concrete structures:

1. Concrete:

   a. Shall conform to Section 903.
   b. Concrete Class: N.J.D.O.T Class "B" unless otherwise required by the Standard Specifications.
   c. Air-entrained.

2. Joint Fillers: Section 914.01, bituminous cellular type.

3. Curing Compound: Section 903.10, white-pigmented liquid.

E. Driveway Restoration: Driveway Aprons shall be replaced in kind with Portland Cement Concrete, or Hot Mix Asphalt. See Section 606 "Sidewalks, Driveways and Islands".

F. Crushed Stone: Stone shall be of the same size, shape and color of existing stone.

G. All other Materials: As approved by the Engineer or authorities having jurisdiction.

SECTION 3 – EXECUTION

3.01 METHODS OF CONDUCTING WORK - CLEANING

A. Requirements of regulatory agencies: All excess material shall be removed from the site and disposed of by the contractor at his expense. Cost to be & included in the unit price bid for all items. The disposal site shall be in permanently established licensed OSWA (Office of Solid Waste Administration, New Jersey Department of Environmental Protection) landfills.

B. Cleaning during construction: Provide periodic cleaning to keep the work, the site, and adjacent properties free from accumulations of waste materials, rubbish and windblown debris resulting from construction operations.

Provide on-site containers for the collection of waste materials, debris and rubbish. Maintain containers as required.

C. Dust Control: The Contractor will be required to maintain all excavations, embankments, stockpiles, haul roads, permanent access roads, plant sites, waste areas, borrow areas, and all other work areas within or without the project boundaries free from dust which would cause a hazard or nuisance to others. Approved temporary methods of stabilization consisting of sprinkling, chemical treatment, light bituminous treatment or similar methods will be permitted to control dust. Sprinkling, to be approved, must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times, and the Contractor must have sufficient competent equipment on the job to accomplish this if sprinkling is used. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs. If any dust control is not done within twenty-four (24) hours after written notice is given by the Engineer, the work may be done by Owner and charged to the Contractor.

3.02 METHODS OF CONDUCTING WORK - RESTORATIONS

A. General: All existing structures, unpaved areas and paved areas disturbed or damaged during the work under this contract shall be restored or replaced to a condition at least equal to that existing prior to beginning work, or as otherwise specified. The methods of conducting this work shall, as a minimum, conform to the following Articles of the New Jersey Department of Transportation Standard Specifications, latest revision.

B. Grass Restorations: See Section 808 “Sodding”.

C. Pavement Restorations: The methods of construction employed shall conform to the requirements set forth in the Standard Specifications as applicable to the type of material being utilized.

D. Restorations of Curbs and Other Concrete Structures:

1. Curbs: Section 607
2. Other concrete structures: Restore in accordance with applicable Articles of the Standard Specifications.

E. All Other Restorations: Restore in accordance with applicable Articles of the Standard Specifications, or as approved by the Engineer or authorities having jurisdiction.

END OF SECTION

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

1.2 DEFINITIONS

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

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Silica fume.
6. Performance-based hydraulic cement
7. Aggregates.
8. Admixtures:

a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

b. Include limitations of use. Admixtures that do not comply with reference ASTM International requirements must be submitted with test data for approval.

9. Color pigments.
10. Fiber reinforcement.
11. Vapor retarders.
12. Floor and slab treatments.
13. Liquid floor treatments.
14. Curing materials.

a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.

15. Joint fillers.
16. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Calculated equilibrium unit weight, for lightweight concrete.
6. Slump limit.
7. Air content.
8. Nominal maximum aggregate size.
9. Steel-fiber reinforcement content.
10. Synthetic micro-fiber content.
11. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
12. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.
13. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.
14. Intended placement method.
15. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:

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

a. Location of construction joints is subject to approval of the Engineer.

D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.
7. Floor treatment if any.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Ready-mixed concrete manufacturer.
3. Testing agency: Include copies of applicable ACI certificates.

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

1. Cementitious materials.
2. Admixtures.
3. Fiber reinforcement.
4. Curing compounds.
5. Floor and slab treatments.
6. Bonding agents.
7. Adhesives.
8. Vapor retarders.
9. Semirigid joint filler.
10. Joint-filler strips.
11. Repair materials.

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

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Silica fume.
6. Performance-based hydraulic cement.
7. Aggregates.
8. Admixtures:

    a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.

D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.

E. Research Reports:

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.

F. Preconstruction Test Reports: For each mix design.

G. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician with experience installing and finishing concrete, incorporating permeability-reducing admixtures.

1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.

B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.

1. Personnel performing laboratory tests to be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor to be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

D. Field Quality-Control Testing Agency Qualifications: An independent agency, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests to be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

1.6 PRECONSTRUCTION TESTING

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

1. Include the following information in each test report:

a. Admixture dosage rates.
b. Slump.
c. Air content.
d. Seven-day compressive strength.
e. 28-day compressive strength.
f. Permeability.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301.

1.8 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

2. 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.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

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

2.2 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I Type II,.
2. Fly Ash: ASTM C618, Class C or F.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

C. Normal-Weight Aggregates: ASTM C33/C33M, 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. Air-Entraining Admixture: ASTM C260/C260M.

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

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
7. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494/C494M, Type C.

8. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

2.3 VAPOR RETARDERS

A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 6 mils thick.

2.4 FLOOR AND SLAB TREATMENTS

A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.

2.5 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

2.6 CURING MATERIALS

A. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

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

a. ChemMasters, Inc.
b. Concrete Sealers USA.
c. Kaufman Products, Inc.

2.7 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.

B. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

C. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:

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

2.8 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 C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
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 in accordance with ASTM C109/C109M.

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 C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.9 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, in accordance with ACI 301.

1. Use a qualified 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 or Other Pozzolans: 25 percent by mass.
2. Slag Cement: 50 percent by mass.
3. Silica Fume: 10 percent by mass.
4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

C. Admixtures: Use admixtures in accordance with 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 corrosion-inhibiting admixture in concrete mixtures where indicated.
4. Use permeability-reducing admixture in concrete mixtures where indicated.

D. Color Pigment: Add color pigment to concrete mixture in accordance with manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.10 CONCRETE MIXTURES

A. Class A: Normal-weight concrete used for footings, grade beams, and tie beams.
1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum w/cm: .48
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content:

a. Exposure Class F1: 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size.

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

B. Class B: Normal-weight concrete used for foundation walls.
1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum w/cm: 0.45.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content:

a. Exposure Class F1: 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size.

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

C. Class C: Normal-weight concrete used for interior slabs-on-ground.
1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum w/cm: 0.45.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content:

a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

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

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and ASTM C1116/C1116M, and furnish batch ticket information.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 TOLERANCES

A. Comply with ACI 117.

3.4 INSTALLATION OF 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.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
3. 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.

3.5 INSTALLATION OF VAPOR RETARDER

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.

1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
2. Face laps away from exposed direction of concrete pour.
3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
4. Lap joints 6 inches and seal with manufacturer's recommended tape.
5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.

6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
7. Protect vapor retarder during placement of reinforcement and concrete.

    a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder in accordance with manufacturer's written instructions.

3.6 INSTALLATION OF CAST-IN-PLACE CONCRETE

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.

1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Engineer and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Water addition in transit or at the Project site must be in accordance with ASTM C94/C94M and must not exceed the permitted amount indicated on the concrete delivery ticket.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.
3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.

    a. Do not use vibrators to transport concrete inside forms.
    b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer.
    c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    d. 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. Do not place concrete floors and slabs in a checkerboard sequence.
2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

3. Maintain reinforcement in position on chairs during concrete placement.
4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.7 JOINTS

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

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Engineer.
2. Place joints perpendicular to main reinforcement.

    a. Continue reinforcement across construction joints unless otherwise indicated.
    b. Do not continue reinforcement through sides of strip placements of floors and slabs.

3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
6. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
8. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

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

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

D. Isolation Joints in Slabs-on-Ground: 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 on Drawings.
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:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.
2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.8 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.

1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Engineer and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer in writing, but not to exceed the amount indicated on the concrete delivery ticket.

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

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.

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

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.
3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.

4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.

    a. Do not use vibrators to transport concrete inside forms.
    b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
    c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    d. 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.

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

3.9 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

    a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
    b. Remove projections larger than 1 inch.
    c. Tie holes do not require patching.
    d. Surface Tolerance: ACI 117 Class D.
    e. Apply to concrete surfaces not exposed to public view.

2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.

    a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
    b. Remove projections larger than 1/4 inch.
    c. Patch tie holes.
    d. Surface Tolerance: ACI 117 Class B.
    e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish.

3. ACI 301 Surface Finish SF-3.0:

a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
b. Remove projections larger than 1/8 inch.
c. Patch tie holes.
d. Surface Tolerance: ACI 117 Class A.
e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

B. Rubbed Finish: Apply the following to as cast surface finishes wherever these type of surfaces are shown on the Drawings:

1. Smooth-Rubbed Finish:

a. Perform no later than one day after form removal.
b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
d. Maintain required patterns or variances as shown on Drawings.

2. Grout-Cleaned Rubbed Finish:

a. Clean concrete surfaces after contiguous surfaces are completed and accessible.
b. Do not clean concrete surfaces as Work progresses.
c. Mix 1 part portland cement to 1-1/2 parts fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
d. Wet concrete surfaces.
e. 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.
f. Maintain required patterns or variances as shown on Drawings.

C. Related Unformed Surfaces:

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

3.10 FINISHING FLOORS AND SLABS

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

B. Scratch Finish:

1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.
3. Apply scratch finish to surfaces to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
3. 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:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. 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.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:

    a. Slabs on Ground:

        1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch and also no more than 1/16 inch in 2 feet.
        2) Specified overall values of flatness, F_F 25; and of levelness, F_L 20; with minimum local values of flatness, F_F 17; and of levelness, F_L 15.
        3) 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.
        4) Specified overall values of flatness, F_F 45; and of levelness, F_L 35; with minimum local values of flatness, F_F 30; and of levelness, F_L 24.
        5) Specified overall values of flatness, F_F 50; and of levelness, F_L 25; with minimum local values of flatness, F_F 40; and of levelness, F_L 17.

    b. Suspended Slabs:

1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
2) Specified overall values of flatness, F_F 25; and of levelness, F_L 20; with minimum local values of flatness, F_F 17; and of levelness, F_L 15.
3) Specified overall values of flatness, F_F 35; and of levelness, F_L 20; with minimum local values of flatness, F_F 24; and of levelness, F_L 15.
4) Specified overall values of flatness, F_F 45; and of levelness, F_L 35; with minimum local values of flatness, F_F 30; and of levelness, F_L 24.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated on Drawings and/or 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 perpendicular to main traffic route.

1. Coordinate required final finish with Engineer before application.
2. 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 locations indicated on Drawings.

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

G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish to concrete stair treads, platforms, ramps as indicated on Drawings

1. Apply in accordance with manufacturer's written instructions and as follows:

a. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in one or two applications.
b. Tamp aggregate flush with surface, but do not force below surface.
c. After broadcasting and tamping, apply float finish.
d. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.

H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces in accordance with manufacturer's written instructions and as follows:

1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer.
2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating.
3. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
4. After final floating, apply a trowel finish.
5. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.11 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. 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:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4000 psi at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.

    a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    b. Cast anchor-bolt insert into bases.
    c. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.

1. Cast-in inserts and accessories, as shown on Drawings.
2. Screed, tamp, and trowel finish concrete surfaces.

3.12 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1, before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:

    a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
    b. Continuous Sprinkling: Maintain concrete surface continuously wet.
    c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
    d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
    e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

        1) Recoat areas subject to heavy rainfall within three hours after initial application.
        2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:

    a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:

        1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

            a) Lap edges and ends of absorptive cover not less than 12 inches.
            b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

        2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.

            a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
            b) Cure for not less than seven days.

        3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than 12 inches.
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.

a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
b) Cure for not less than seven days.

3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

c. Floors to Receive Polished Finish: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than 12 inches.
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

d. Floors to Receive Chemical Stain:

1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.

2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
3) Butt sides of curing paper tight; do not overlap sides of curing paper.
4) Leave curing paper in place for duration of curing period, but not less than 28 days.

e. Floors to Receive Urethane Flooring:

1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
2) Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped 6 inches and sealed in place.
3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.

f. Floors to Receive Curing Compound:

1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Maintain continuity of coating, and repair damage during curing period.
4) 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 does not interfere with bonding of floor covering used on Project.

g. Floors to Receive Curing and Sealing Compound:

1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.13 APPLICATION OF LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
3. Rinse with water; remove excess material until surface is dry.
4. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

3.14 JOINT FILLING

A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
   1. 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 joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.

D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.15 CONCRETE SURFACE REPAIRS

A. Defective Concrete:

   1. Repair and patch defective areas when approved by Engineer.
   2. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 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.

      a. Limit cut depth to 3/4 inch.
      b. Make edges of cuts perpendicular to concrete surface.
      c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
      d. Fill and compact with patching mortar before bonding agent has dried.
      e. 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 matches surrounding color.

      a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
      b. Compact mortar in place and strike off slightly higher than surrounding surface.

   3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Engineer.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.

    a. Correct low and high areas.
    b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

2. Repair finished surfaces containing surface defects, including 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.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.

    a. Finish repaired areas to blend into adjacent concrete.

5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.

    a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
    b. Feather edges to match adjacent floor elevations.

6. Correct other low areas scheduled to remain exposed with repair topping.

    a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
    b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.

    a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
    b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
    c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
    d. Place, compact, and finish to blend with adjacent finished concrete.
    e. Cure in same manner as adjacent concrete.

8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.

    a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
    b. Dampen cleaned concrete surfaces and apply bonding agent.

c. Place patching mortar before bonding agent has dried.
d. Compact patching mortar and finish to match adjacent concrete.
e. Keep patched area continuously moist for at least 72 hours.

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

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

3.16 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Article. The scheduling and costs for all testing shall be the responsibility of the contractor.
1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
2. Testing agency to immediately report to Engineer, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency to report results of tests and inspections, in writing, to Owner, Engineer, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:

1) Project name.
2) Name of testing agency.
3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
4) Name of concrete manufacturer.
5) Date and time of inspection, sampling, and field testing.
6) Date and time of concrete placement.
7) Location in Work of concrete represented by samples.
8) Date and time sample was obtained.
9) Truck and batch ticket numbers.
10) Design compressive strength at 28 days.
11) Concrete mixture designation, proportions, and materials.
12) Field test results.
13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
14) Type of fracture and compressive break strengths at seven days and 28 days.

B. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

C. Inspections:

1. Headed bolts and studs.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.
5. 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 in accordance with ASTM C 172/C 172M to be performed in accordance with 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 provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M:

    a. 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.
    b. Perform additional tests when concrete consistency appears to change.

3. Slump Flow: ASTM C1611/C1611M:

    a. 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.
    b. Perform additional tests when concrete consistency appears to change.

4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete;

    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

5. Concrete Temperature: ASTM C1064/C1064M:

    a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.

6. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.

    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

7. Compression Test Specimens: ASTM C31/C31M:

    a. Cast and laboratory cure two sets of two 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.

b. Cast, initial cure, and field cure two sets of three standard cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C39/C39M.

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

9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. 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 if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests:

    a. Testing and inspecting agency to 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 Engineer.
    b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Engineer.

       1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.

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 in accordance with ASTM E1155 within 48 hours of completion of floor finishing and promptly report test results to Engineer.

3.17 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.

3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

PART 4 - MEASUREMENT, QUANTITY & PAYMENT

Cost for work specified in this section shall be paid for under the bid form line items for which they are a part. Costs shall include all excavation, shoring, formwork, finishes, steel reinforcement, reinforcement accessories, concrete materials, admixtures, water stops, vapor barriers, treatments, curing materials, joint fillers, bonding agents, adhesives, repair materials, testing, and all related appurtenances as required per the contract documents.

END OF SECTION 033000

SECTION 036000

GROUTING

PART 1 - GENERAL

1.1 SUMMARY

This Specification shall be read as a whole by all parties concerned. Each Section may contain more or less the complete Work of any trade. The Contractor is solely responsible to make clear to the Subcontractors the extent of their Work and coordinate overlapping Work.

1.2 SYSTEM DESCRIPTION

This specification describes the grouting of cavities, voids, keyways, etc. with a portland cement, non-shrink, non-metallic grout.

1.3 REFERENCES

The following standards are applicable to this section:

- ASTM C-266 – Time of Set
- ASTM C-939 – Fluidity
- ASTM C-109 – Compressive Strength
- ASTM C-940 - Expansion
- ASTM C-1090 – Shrinkage
- ASTM C-1107 – Standard Specification for Non-shrink Grouts

1.4 QUALITY ASSURANCE

A. Manufacturing qualifications: The manufacturer of the specified product shall be ISO 9001 certified and have in existence a recognized ongoing quality assurance program independently audited on a regular basis.

B. Contractor qualifications: Contractor shall be qualified in the field of grouting with a successful track record of 5 years or more.

C. Store and apply materials in accordance with all safety and weather conditions required by manufacturer or as modified by applicable rules and regulations of local, state and federal authorities having jurisdiction. Consult Material Safety Data Sheets for complete handling recommendations.

1.5 DELIVERY, STORAGE, AND HANDLING

A. All materials must be delivered in original, unopened containers with the manufacturer's name, labels, product identification, and batch numbers. Damaged material must be removed from the site immediately.

B. Store all materials off the ground and protect from rain, freezing or excessive heat until ready for use.

C. Condition the specified product as recommended by the manufacturer.

1.6 JOB CONDITIONS

A. Environmental Conditions: Do not apply material if it is raining or snowing or if such conditions appear to be imminent. Minimum application temperature 45°F (7°C) and rising.

B. Protection: Precautions should be taken to avoid damage to any surface near the work zone due to mixing and handling of the specified material.

1.7 SUBMITTALS

A. Submit two copies of manufacturer's literature, to include: Product Data Sheets (PDS), and appropriate Safety Data Sheets (SDS).

1.8 WARRANTY

Provide a written warranty from the manufacturer against defects of materials for a period of one (1) year, beginning with date of substantial completion of the project.

PART 2 - PRODUCTS

2.1 MANUFACTURER

SikaGrout®-212, as manufactured by Sika® Corporation, is considered to conform to the requirements of this specification, or approved equal.

2.2 MATERIALS

A. The material shall be a blend of selected portland cements, specially graded aggregates, admixtures for controlling setting time and water reducers for workability.

B. The material shall be non-combustible both before and after cure

C. The material shall be supplied in a factory-blended bag

Portland cement grout:

D. The portland cement grout shall be a non-shrink, non-metallic composition containing a blend of selected Portland cements, plasticizing/water-reducing admixtures and shrinkage compensating agents. The shrinkage agents shall compensate for shrinkage in both the plastic and hardened state.

E. Materials for forming, as required for the designated work, shall be approved by the Engineer.

F. Curing compound, conforming to ASTM C-309, as required for the designated work, shall be approved by the Engineer.

2.3 PERFORMANCE CRITERIA

A. The grout shall not exhibit bleeding. The grout shall be segregate.

B. The grout shall be pumpable through standard grout pumping equipment. The grout shall not produce a vapor barrier.

C. The grout shall exhibit positive expansion when tested in accordance to ASTM C-827.

D. The grout shall conform to United States Army Corps of Engineers Specification CRD C-621. The grout shall conform to ASTM C-1107.

E. The material shall be approved by the United States Department of Agriculture.

Typical Properties of the mixed polymer-modified, portland cement mortar:

1	Yield	0.44 ft^3 (0.01 m^3) at fluid consistency
2	Color	Gray powder
3	Mixing Ratio	**Plastic** - 6 pt **Flowable** – 6.5 pt **Fluid** – 8.5 pt
4	Application Thickness	Min: 1/2" (12.7 mm) Max: 4" (101.6 mm)
5	Application Temp	< 45 °F (7 °C)
6	Flowability (ASTM C-1437[1] ASTM C-939[2])	**Plastic**[1]: 100–124 % **Flowable**[1]: 124–145 %
7	Set time (ASTM C-266) flowable consistency	Initial: 4.0–5.0 h Final: 5.5–6.5 h
8	Compressive Strength (ASTM C-109)	**Plastic** 1 day - 4,500 psi (31 MPa) 7 days - 6,100 psi (42 MPa) 28 days - 7,500 psi (51.7 MPa) **Flowable** 1 day - 3,500 psi (24.1 MPa) 7 days - 5,700 psi (39.3 MPa) 28 days - 6,200 psi (42.7 MPa) **Fluid** 1 day - 2,700 psi (18.6 MPa) 7 days - 5,500 psi (37.9 MPa) 28 days - 5,800 psi (40 MPa)
9	Flexural Strength (ASTM C-293)	**Plastic** 28 days - 1,400 psi (9.6 MPa) **Flowable** 28 days - 1,200 psi (8.2 MPa)
10	Splitting Tensile Strength (ASTM C-496)	**Plastic** 28 days - 600 psi (4.1 MPa) **Flowable** 28 days - 575 psi (3.9 MPa) **Fluid** 28 days - 500 psi (3.4 MPa)
11	Tensile Adhesion Strength (ASTM C-882 modified)	**Plastic** 28 days - 2,000 psi (13.7 MPa) **Flowable** 28 days - 1,900 psi (13.1 MPa)
12	Expansion (ASTM C-1090)	**Plastic** 28 days +0.021 % **Flowable** 28 days +0.056 % **Fluid** 28 days +0.027 %

Note: Tests above were performed with the material and curing conditions @ 71°F – 75°F and 45 - 55% relative humidity.

PART 3 – EXECUTION

3.1 SURFACE PREPARATION

Areas to be repaired must be clean, sound, and free of contaminants. All loose and deteriorated concrete shall be removed by mechanical means. Mechanically prepare concrete substrate to obtain a surface profile of CSP 4 or greater (as per ICRI Guidelines) with a new exposed aggregate surface.

3.2 MIXING AND APPLICATION

A. Mixing of the portland cement grout: Mix manually or mechanically. Manually mix in a wheelbarrow or mortar box. Mechanically mix with a low-speed (400-600 rpm) drill and jiffy paddle or in an appropriate sized mortar mixer. Add an appropriate quantity of water to the mixing container to achieve the desired consistency. DO NOT OVERWATER While mixing the bag of powder is slowly added to the mixer. Mix to a uniform consistency for a minimum of 2 minutes. Mix temperature should be maintained at 70-75F, thus using cold or warm water accordingly.

B. Placement Procedure:

Spalls: Within 15 minutes of mixing, pour the grout into the prepared form. Work in a manner to avoid air entrapment. Vibrate the form as required to achieve flow and compaction. Flowable grout must be confined in either the horizontal or vertical direction, leaving a minimum of exposed surface. After the grout has achieved its final set, remove any forms and trim or shape exposed mortar/concrete to the desired profile, if required.

Cracks: Within 15 minutes of mixing pour the grout into prepared crack. Continue pouring until the crack has been completely filled.

C. Wet cure for a minimum of 3 days or apply a curing compound that conforms to ASTM C-309 as approved by the Engineer.

D. Adhere to all limitation and cautions for the polymer-modified portland cement coating in the manufacturers printed Product Data Sheet (PDS) and literature.

3.3 CLEANING

A. The uncured polymer-modified portland cement mortar can be cleaned from tools with water. The cured polymer modified portland cement mortar can only be removed mechanically.

B. Leave finished work and work area in a neat, clean condition without evidence of spillovers onto adjacent areas.

SECTION 042613 - MASONRY VENEER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Concrete face brick.
3. Ties and anchors.

B. Products Installed but not Furnished under This Section:

1. Cast-stone trim in masonry veneer.
2. Stone trim units in unit masonry.
3. Steel lintels in masonry veneer.
4. Steel shelf angles for supporting masonry veneer.

C. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for installing dovetail slots or channel slots for masonry-veneer anchors.
2. Section 051200 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
3. Section 071900 "Water Repellents" for water repellents applied to unit masonry assemblies.
4. Section 076200 "Sheet Metal Flashing and Trim" for [exposed] sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at .

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection:

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1. Decorative CMUs, in the form of small-scale units.
2. Concrete face brick, in the form of small-scale units.
3. Colored mortar.
4. Weep/cavity vents.

D. Samples for Verification: For each type and color of the following:

1. Special brick shapes.
2. Decorative CMUs.
3. Concrete face brick.
4. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project.
5. Weep/cavity vents.
6. Cavity drainage material.
7. Accessories embedded in masonry.

1.4 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include data on material properties.
b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
c. For exposed brick, include test report for efflorescence in accordance with ASTM C67/C67M.
d. For surface-coated brick, include test report for durability of surface appearance after 50 cycles of freezing and thawing in accordance with ASTM C67/C67M or a list of addresses of buildings in Project's area where proposed brick has been used successfully and with a history of durability.

2. Integral water repellant used in decorative CMUs.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Anchors, ties, and metal accessories.

C. Qualification Statements: For testing agency.

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D. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.

E. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Installers: All masonry flashing installers must complete the International Masonry Institute Flashing Upgrade training course.
2. Testing Agency: Qualified in accordance with ASTM C1093 for testing indicated.

1.6 MOCKUPS

A. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.

1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 60 inches long by 48 inches high [by full thickness].
2. Build sample panels facing south.
3. Where masonry is to match existing, build panels adjacent and parallel to existing surface.
4. Clean [one-half of] exposed faces of panels with masonry cleaner indicated.
5. Protect approved sample panels from the elements with weather-resistant membrane.
6. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.

a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.

B. Wall Mockups: Build mockups to verify selections made under Sample submittals. [See Section 014339 "Mockups" for additional construction requirements for integrated exterior mockups.]

1. Build mockup [as indicated on Drawings]<Insert mockup requirements>.
2. Build mockups for each type of exposed unit masonry construction in sizes approximately 60 inches long by 48 inches high by full thickness, including face and backup wythes and accessories.

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a. Include a sealant-filled joint at least 16 inches long in [each] mockup.
b. Include lower corner of window opening [, framed with stone trim,] at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
d. Include [metal][wood] studs, sheathing, [water-resistive barrier][sheathing joint-and-penetration treatment][air barrier], veneer anchors, flashing [, cavity drainage material], and weep holes in exterior masonry-veneer wall mockup.

3. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
4. Clean [one-half of] exposed faces of mockups with masonry cleaner as indicated.
5. Protect accepted mockups from the elements with weather-resistant membrane.
6. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
7. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

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

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

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

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

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

1.8 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of veneer, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

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1. Extend cover a minimum of 24 inches down face of veneer, and hold cover securely in place.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry. Immediately remove grout, mortar, and soil that come in contact with 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.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain exposed masonry units cementitious mortar components from single producer or manufacturer.

B. For exposed masonry units and cementitious mortar components, obtain each color and grade from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects will be exposed in the completed Work and will be within 20 ft. vertically and horizontally of a walking surface.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly

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designs indicated.

1. Where fire-resistance-rated construction is indicated, units are listed by UL or a qualified testing agency acceptable to authorities having jurisdiction.

2.3 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units.

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications [where stretcher units cannot accommodate special conditions, including corners, movement joints, bond beams, sashes, and lintels][requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing][where shapes produced by sawing would result in sawed surfaces being exposed to view].

2.4 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

B. Concrete Face Brick: ASTM C1634, normal weight.

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. ANCHOR BLOCK
   b. EP HENRY

2. Size (Actual Dimensions): 3-5/8 inches wide by 3-5/8 inches high by 15-5/8 inches long.
3. Texture: Ground-face finish <Insert description>. Match Architect's samples
4. Colors: .
5. Special Aggregate: Provide units made with aggregate matching aggregate in Architect's sample.

2.5 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

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1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Colored Cement Products: Packaged blend made from portland cement and hydrated lime 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 do not exceed 10 percent of portland cement by weight.
3. Pigments do not exceed 5 percent of masonry cement mortar cement by weight.

E. Aggregate for Mortar: ASTM C144.

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.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

F. Water: Potable.

2.6 TIES AND ANCHORS

A. General: Ties and anchors extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Mill-Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A641/A641M, Class 1 coating.
2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.
3. Stainless Steel Wire: ASTM A580/A580M, Type 316.
4. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 zinc coating.
5. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
6. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 316.

C. Corrugated-Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from

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0.0635-inch- thick, steel sheet, galvanized after fabrication.

D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, stainless steel wire. [Mill-galvanized wire may be used at interior walls unless otherwise indicated.]
2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- diameter, stainless steel wire. [Mill-galvanized wire may be used at interior walls unless otherwise indicated.]

E. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into channel slots in concrete and attached to tie section; formed from 0.105-inch- thick, steel sheet, galvanized after fabrication.

    a. [0.064-inch-][0.108-inch-] thick, galvanized-steel sheet may be used at interior walls unless otherwise indicated.

2. Tie Section: Triangular-shaped wire tie made from 0.25-inch- diameter, stainless steel wire. [Mill-galvanized wire may be used at interior walls unless otherwise indicated.]
3. Corrugated-Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from 0.1084-inch- thick steel sheet, galvanized after fabrication with [dovetail][channel] tabs for inserting into dovetail slots in concrete.

    a. 0.079-inch- thick, galvanized sheet may be used at interior walls unless otherwise indicated.

F. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a 100 lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.1084-inch- thick steel sheet, galvanized after fabrication.
3. Fabricate wire ties from 0.187-inch- diameter, stainless steel wire unless otherwise indicated.
4. Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified.
5. Masonry-Veneer Anchors; Slotted Plate with Prongs: Sheet metal anchor section, with screw holes at top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation; and raised rib-stiffened strap, stamped into center to provide a slot between strap and base for wire tie. Use self-adhering tape to seal penetration behind anchor plate.

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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) Hohmann & Barnard, Inc
2) Wire-Bond

6. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours in accordance with ASTM B117.
7. Stainless Steel Drill Screws for Steel Studs: ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads; either made from Type 410 stainless steel or made with a carbon-steel drill point and 300 Series stainless steel shank.

2.7 EMBEDDED FLASHING

A. Flexible Flashing: Use [one of] the following unless otherwise indicated:

1. Copper Fabric Flashing: 7 oz./sq. ft. copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

a. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

1) [Advanced Building Products Inc.]
2) [Hohmann & Barnard, Inc]
3) [STS Coatings, Inc.]
4) [Wire-Bond]
5) [York Manufacturing, Inc]
6) <Insert manufacturer's name>

B. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

1. Solder for Stainless Steel: ASTM B32, Grade Sn96, with acid flux of type recommended by stainless steel sheet manufacturer.
2. Solder for Copper: ASTM B32, Grade Sn50.
3. Elastomeric Sealant: ASTM C920, chemically curing silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and remain watertight.

C. 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.

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D. Termination Bars for Flexible Flashing: Stainless steel steel bars 1/8 inch by 1-1/8 inch.

E. Termination Bars for Flexible Flashing, Flanged: Stainless steel sheet 0.019 inch by 1-1/2 inches with a 3/8-inch flange at top and bottom.

2.8 ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Weep/Vent Products: Use one of the following unless otherwise indicated:

1. Wicking Material: Absorbent rope, made from cotton, 1/4 to 3/8 inch in diameter, in length required to produce 2-inch exposure on exterior and 18 inches in cavity. 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. Vinyl Weep Hole/Vent: Units made from flexible 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 selected by Architect.

    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) Hohmann & Barnard, Inc
        2) Williams Products, Inc.
        3) Wire-Bond

C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Mortar Deflector: Strips, full depth of cavity and [10 inches][16 inches]<Insert thickness> high, with [dovetail-shaped notches][dimpled surface] that prevent clogging with mortar droppings.

    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) Hohmann & Barnard, Inc
        2) Mortar Net Solutions
        3) Wire-Bond

2. Rainscreen Drainage Mat: Sheets or strips not less than full depth of cavity thick and installed to full height of cavity, [with additional strips 4 inches high at weep

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holes and thick enough to fill entire depth of cavity] to prevent weep holes from clogging with mortar.

a. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

1) [Advanced Building Products Inc.]
2) [CavClear; a division of Archovations, Inc.]
3) [Keene Building Products]
4) [Mortar Net Solutions]
5) [Wire-Bond]
6) <Insert manufacturer's name>

2.9 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime or mortar cement mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime or mortar cement mortar.
4. For reinforced masonry, use portland cement-lime or mortar.
5. 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 C270, Property Specification. Use Type N unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type S.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments do not exceed 10 percent of portland cement by weight.
2. Pigments do not exceed 5 percent of masonry cement or mortar cement by weight.
3. Mix to match Architect's sample.
4. Application: Use pigmented mortar for exposed mortar joints.

E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

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1. Mix to match Architect's sample.
2. Application: Use colored-aggregate mortar for exposed mortar joints.

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 the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 INSTALLATION, GENERAL

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

B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

D. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

E. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

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

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B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
7. 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.

C. Joints:

1. For 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.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.
5. 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.

3.4 LAYING MASONRY WALLS

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

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in bond pattern indicated on Drawings; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by stepping 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, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other

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Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

A. 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.

B. Lay hollow brick and CMUs with face shells fully bedded in mortar and with head joints of depth equal to bed joints. At starting course, fully bed entire units, including area under cells.

1. At anchors and ties, fully bed units and fill cells with mortar as needed to fully embed anchors and ties in mortar.

C. Set trim units in full bed of mortar with full vertical joints.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Allow cleaned surfaces to dry before setting.
3. Wet joint surfaces thoroughly before applying mortar.
4. Rake out mortar joints for pointing with sealant.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

1. For glazed masonry units, use a nonmetallic jointer 3/4 inch or more in width.

3.6 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to concrete and masonry backup with [seismic] masonry-veneer anchors to comply with the following requirements:

1. Fasten anchors to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed tie sections connector sections and continuous wire in masonry joints.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than one anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.
5. Space anchors as indicated, but not more than 16 inches o.c. vertically and 25 inches o.c. horizontally, with not less than one anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

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6. Space anchors as indicated, but not more than 18 inches o.c. vertically and horizontally. Install additional anchors within 12 inches of openings and at intervals, not exceeding 24 inches, around perimeter.

B. Provide not less than 2 inches of airspace between back of masonry veneer and face of sheathing.

1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

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

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

3.8 EXPANSION JOINTS

A. General: Install expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.

B. Form expansion joints as follows:

1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
2. Build flanges of factory-fabricated, expansion-joint units into masonry.
3. Build in compressible joint fillers where indicated.
4. Form open joint full depth of brick wythe and of width indicated, but not less than [3/8 inch][1/2 inch]<Insert minimum width> for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."

C. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than [3/8 inch]<Insert minimum width>.

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

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3.9 LINTELS

A. Install steel lintels where indicated.

B. Provide offset angle supports where indicate and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are indicated without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 FLASHING, WEEP HOLES, 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. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, 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. Extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under water-resistive barrier, lapping at least 4 inches. [Fasten upper edge of flexible flashing to sheathing through termination bar.]
3. At lintels and shelf angles, extend flashing 6 inches minimum , to edge of next full unit at each end. At heads and sills, extend flashing 6 inches minimum , to edge of next full unit and turn ends up not less than 2 inches to form end dams.
4. Interlock end joints of sawtooth 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 Section 079200 "Joint Sealants" for application indicated.
5. Install metal drip edges with sawtooth sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
6. 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.
7. 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.
8. 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 indicated to be built into masonry.

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D. Install weep holes in veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/cavity vent products to form weep holes.
2. Use wicking material to form weep holes above flashing under brick 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 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 airspace behind veneers to comply with configuration requirements for cavity drainage material in "Accessories" Article.

F. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.

B. Inspections: Special inspections in accordance with Level 2 in TMS 402.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

C. Testing Prior to Construction: One set of tests.

D. Clay Masonry Unit Test: For each type of unit provided, in accordance with ASTM C67/C67M for compressive strength.

E. Concrete Masonry Unit Test: For each type of unit provided, in accordance with ASTM C140/C140M for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.

G. Mortar Test (Property Specification): For each mix provided, in accordance with ASTM C780. Test mortar for mortar air content and compressive strength.

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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 brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

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 Section 312000 "Earth Moving."
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 or recycled, and other masonry waste, and legally dispose of off Owner's property.

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SECTION 047200 - CAST STONE MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Related Requirements:

1. Section 034500 "Precast Architectural Concrete."

1.2 ACTION SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.

1. Include building elevations showing layout of units and locations of joints and anchors.

C. Samples for Initial Selection: For colored mortar.

D. Samples for Verification:

1. Cast Stone Trim Units: For each trim shape required, 4 inches in length.
2. Colored Mortar: Make Samples using same sand and mortar ingredients to be used on Project. [Label Samples to indicate types and amounts of pigments used.]

E. Full-Size Samples: For each [color][texture][engraving][and][shape] of cast stone unit required.

1. Make available for Architect's review at Project site [or at manufacturing plant, if acceptable to Architect].
2. Make Samples from materials to be used for units used on Project [immediately before beginning production of units for Project].
3. Approved Samples may be installed in the Work.

F. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party-Certified Life-Cycle Assessment: For each product.

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1.3 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For each mix required to produce cast stone, based on testing in accordance with ASTM C1364.

1. Provide test reports based on testing within previous six months.

B. Qualification Statements: For [manufacturer][and][testing agency].

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer of cast stone units similar to those indicated for this Project, that has sufficient production capacity to manufacture required units, and is a plant certified by [CSI][or][APA][or][PCI for Group A, Category AT].

B. Testing Agency Qualifications: Qualified in accordance with ASTM E329 for testing indicated.

1.5 MOCKUPS

A. Furnish cast stone for installation in mockups specified in [Section 042000 "Unit Masonry."][Section 042613 "Masonry Veneer."]

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 for <Insert description> installation [including accessories].

a. Size: <Insert dimension>[As indicated on Drawings].

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Coordinate delivery of cast stone [with unit masonry work] to avoid delaying the Work [and to minimize the need for on-site storage].

B. Pack, handle, and ship cast stone units in suitable packs or pallets.

1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units if required, using dollies with wood supports.
2. Store cast stone units on wood skids or pallets with nonstaining, waterproof

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covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.

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

D. Store mortar aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

E. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

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

1.7 FIELD CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements in TMS 402/602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until cast stone has dried, but no fewer than seven days after completing cleaning.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements in TMS 402/602.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Cast Stone: Obtain cast stone units from single source from single manufacturer.

B. Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

2.2 CAST STONE MATERIALS

A. General: Comply with ASTM C1364.

B. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C33/C33M; gradation and colors as needed to produce required cast stone textures and colors.

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C. Fine Aggregates: Natural sand or crushed stone complying with ASTM C33/C33M, gradation and colors as needed to produce required cast stone textures and colors.

D. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, [free of carbon black,] nonfading, and resistant to lime and other alkalis.

E. Admixtures: Use only admixtures specified or approved in writing by Architect.

1. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use admixtures containing calcium chloride.
2. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.
3. Air-Entraining Admixture: ASTM C260/C260M. [Add to mixes for units exposed to the exterior at manufacturer's prescribed rate to result in an air content of 4 to 6 percent, except do not add to zero-slump concrete mixes.]
4. Water-Reducing Admixture: ASTM C494/C494M, Type A.
5. Water-Reducing, Retarding Admixture: ASTM C494/C494M, Type D.
6. Water-Reducing, Accelerating Admixture: ASTM C494/C494M, Type E.

F. Reinforcement:

1. Deformed steel bars complying with ASTM A615/A615M, Grade 40. Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches of cast stone material.

a. Epoxy Coating: ASTM A775/A775M.
b. Galvanized Coating: ASTM A767/A767M.

2. Plain-Steel, Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.
3. Galvanized-Steel, Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from galvanized-steel wire into flat sheets.
4. Fiber Reinforcement: ASTM C1116/C1116M.

G. Embedded Anchors and Other Inserts: Fabricated from [stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666, Type 304][stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666, Type 316][steel complying with ASTM A36/A36M and hot-dip galvanized to comply with ASTM A123/A123M].

2.3 FABRICATION OF CAST STONE MASONRY

A. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.

1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
3. Provide drips on projecting elements unless otherwise indicated.

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B. Fabrication Tolerances:

1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch.
2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch, whichever is greater, but in no case by more than 1/4 inch.
3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch, whichever is greater.
4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch on formed surfaces of units and 3/8 inch on unformed surfaces.

C. Cure Units as Follows:

1. Cure units in enclosed, moist curing room at 95 percent relative humidity and temperature of 100 deg F for 12 hours or 70 deg F for 16 hours.
2. Keep units damp and continue curing to comply with one of the following:

   a. No fewer than five days at mean daily temperature of 70 deg F or above.
   b. No fewer than seven days at mean daily temperature of 50 deg F or above.

D. Acid etch units after curing to remove cement film from surfaces to be exposed to view.

2.4 MORTAR MATERIALS

A. Provide mortar materials that comply with [Section 042000 "Unit Masonry."][Section 042613 "Masonry Veneer."]

B. General: Provide mortar and grout materials to achieve performance requirements as specified in mortar and grout mixes.

C. Colored Cement Products: Packaged blend made from [portland cement and hydrated 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 do not exceed 10 percent of portland cement by weight.
3. Pigments do not exceed 5 percent of [masonry cement][or][mortar cement] by weight.

D. Aggregate for Mortar: ASTM C144.

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.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored Aggregates: Natural sand or crushed stone of color necessary to

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produce required mortar color.

E. Water: Potable.

2.5 ACCESSORIES

A. Anchors: Type and size indicated, fabricated from [Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666][Type 316 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666][steel complying with ASTM A36/A36M and hot-dip galvanized to comply with ASTM A123/A123M].

B. Dowels: 1/2-inch- diameter round bars, fabricated from [Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666][Type 316 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666][steel complying with ASTM A36/A36M and hot-dip galvanized to comply with ASTM A123/A123M].

2.6 MORTAR MIXES

A. Comply with requirements in [Section 042000 "Unit Masonry"][Section 042613 "Masonry Veneer"] for mortar mixes.

B. General: Do not use admixtures including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use [portland cement-lime][masonry cement][or][mortar cement] mortar unless otherwise indicated.

C. Mortar for Cast Stone Masonry: Comply with ASTM C270, Proportion Specification.

1. For setting mortar, use [Type S][Type N].
2. For pointing mortar, use [Type N][Type O].

D. Preblended, Dry Mortar Mix: Comply with ASTM C1714/C1714M and capable of producing mortar strength as indicated in ASTM C270.

1. For setting mortar, use [Type S][Type N].
2. For pointing mortar, use [Type N][Type O].

E. Pigmented Mortar: Use colored cement product [or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products].

1. Pigments do not exceed 10 percent of portland cement by weight.
2. Pigments do not exceed 5 percent of [masonry cement][or][mortar cement] by weight.

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3. Mix to match Architect's sample.
4. Application: Use pigmented mortar for exposed mortar joints.

F. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

1. Mix to match Architect's sample.
2. Application: Use colored-aggregate mortar for exposed mortar joints.

2.7 SOURCE QUALITY CONTROL

A. Engage a qualified independent testing agency to sample and test cast stone units in accordance with ASTM C1364.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, 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 SETTING CAST STONE IN MORTAR

A. Set cast stone as indicated in TMS 604.

B. Install cast stone units to comply with requirements in [Section 042000 "Unit Masonry."][Section 042613 "Masonry Veneer."]

C. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned in accordance with established relationships and indicated tolerances.

1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
2. Coordinate installation of cast stone with installation of flashing specified in other Sections.

D. Wet joint surfaces thoroughly before applying mortar or setting in mortar.

E. Set units in full bed of mortar with full head joints unless otherwise indicated.

1. Set units with joints [1/4 to 3/8 inch][3/8 to 1/2 inch]<Insert dimension> wide unless otherwise indicated.
2. Build anchors and ties into mortar joints as units are set.

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3. Fill dowel holes and anchor slots with mortar.
4. Fill collar joints solid as units are set.
5. Build concealed flashing into mortar joints as units are set.
6. Keep head joints in copings and between other units with exposed horizontal surfaces open to receive sealant.
7. Keep joints at shelf angles open to receive sealant.

F. Rake out joints for pointing with mortar to depths of not less than 3/4 inch. Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.

G. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 inch. Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.

H. Tool exposed joints slightly concave when thumbprint hard. Use a smooth plastic jointer larger than joint thickness.

I. Rake out joints for pointing with sealant to depths of not less than 3/4 inch. Scrub faces of units to remove excess mortar as joints are raked.

J. Point joints with sealant to comply with applicable requirements in Section 079200 "Joint Sealants."

1. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.

K. Provide sealant joints at head joints of copings and other horizontal surfaces; at expansion, control, and pressure-relieving joints; and at locations indicated.

1. Keep joints free of mortar and other rigid materials.
2. Build in compressible foam-plastic joint fillers where indicated.
3. Form joint of width indicated, but not less than [3/8 inch][1/2 inch]<Insert dimension>.
4. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
5. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.3 SETTING ANCHORED CAST STONE WITH SEALANT-FILLED JOINTS

A. Set cast stone as indicated in TMS 604.

B. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned in accordance with established relationships and indicated tolerances.

1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
2. Shim and adjust anchors, supports, and accessories to set cast stone in

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locations indicated with uniform joints.

C. Keep cavities open where unfilled space is indicated between back of cast stone units and backup wall; do not fill cavities with mortar or grout.

D. Fill anchor holes with sealant.

1. Where dowel holes occur at pressure-relieving joints, provide compressible material at ends of dowels.

E. Set cast stone supported on clip or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths. Hold shims back from face of cast stone a distance at least equal to width of joint.

F. Keep joints free of mortar and other rigid materials. Remove temporary shims and spacers from joints after anchors and supports are secured in place and cast stone units are anchored. Do not begin sealant installation until temporary shims and spacers are removed.

1. Form open joint of width indicated, but not less than [3/8 inch][1/2 inch]<Insert dimension>.

G. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.

H. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.4 INSTALLATION TOLERANCES

A. Variation from Plumb: Do not exceed [1/4 inch in 10 ft.][1/8 inch in 10 ft.], [3/8 inch in 20 ft.][1/4 inch in 20 ft.], or 1/2 inch maximum.

B. Variation from Level: Do not exceed [1/4 inch in 10 ft.][1/8 inch in 10 ft.], [3/8 inch in 20 ft.][1/4 inch in 20 ft.], or 1/2 inch maximum.

C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches or one-fourth of nominal joint width, whichever is less.

D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch, except where variation is due to warpage of units within tolerances specified.

3.5 ADJUSTING

A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.

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B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.

3.6 CLEANING

A. In-Progress Cleaning: Clean cast stone as work progresses.

1. Remove mortar fins and smears before tooling joints.
2. Remove excess sealant immediately, including spills, smears, and spatter.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
5. Clean cast stone by methods described in Cast Stone Institute Technical Bulletin #39.
6. Clean cast stone with proprietary acidic cleaner applied in accordance with manufacturer's written instructions.

END OF SECTION 047200

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SECTION 048100

UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions of the Contract, as applicable.

1.2 SUMMARY

A. This Section includes unit masonry assemblies consisting of the following:

1. Concrete masonry units.
2. Decorative concrete masonry units.
3. Mortar and grout.
4. Reinforcing steel.
5. Masonry joint reinforcement.
6. Ties and anchors.
7. Embedded flashing.
8. Miscellaneous masonry accessories.
9. Masonry-cell insulation.

B. Products installed, but not furnished, under this Section include the following:
1. Steel lintels for unit masonry, furnished under Misc. Metals
2. Hollow-metal frames in unit masonry openings, furnished under Steel Doors and Frames.

1.3 SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details for the following:
1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection: For the following:

1. Unit masonry Samples in small-scale form showing the full range of colors and textures available for each different exposed masonry unit required.
2. Colored mortar Samples showing the full range of colors available.

D. Samples for Verification: For the following:

1. Full-size units for each different exposed masonry unit required, showing the full range of exposed colors, textures, and dimensions to be expected in the completed construction.
2. Colored mortar Samples for each color required, showing the full range of colors expected in the finished construction. Make samples using the same sand and mortar ingredients to be used on Project.
3. Weep holes/vents in color to match mortar color.
4. Accessories embedded in the masonry.

E. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

1. Each type of masonry unit required.
   a. Include test data, measurements, and calculations establishing net-area compressive strength of masonry units.
2. Each cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.
3. Each material and grade indicated for reinforcing bars.
4. Each type and size of joint reinforcement.
5. Each type and size of anchor, tie, and metal accessory.

1.4 QUALITY ASSURANCE

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

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

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

D. Sample Panels: Before installing unit masonry, build sample panels, using materials indicated for the completed Work, to verify selections made under sample Submittals and to demonstrate aesthetic effects. Build sample panels for each type of exposed unit masonry assembly in sizes approximately 48 inches (1200 mm) long by 48 inches (1200 mm) high by full thickness.

1. Locate panels in the locations indicated or, if not indicated, as directed by Architect.
2. Clean exposed faces of panels with masonry cleaner indicated.
3. Where masonry is to match existing, erect panels adjacent and parallel to existing surface.
4. Protect approved sample panels from the elements with weather-resistant membrane.
5. Maintain sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
6. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
   a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels, unless such deviations are specifically approved by Architect in writing.
7. Demolish and remove sample panels when directed.

1.5 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.

1.6 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches (600 mm) down both sides and hold cover securely in place.
2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) 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 coverings spread on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

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.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.

1. When ambient temperature exceeds 100 deg F (38 deg C), or 90 deg F (32 deg C) with a wind velocity greater than 8 mph (13 km/h), do not spread mortar beds more than 48 inches (1200 mm) ahead of masonry. Set masonry units within one minute of spreading mortar.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. General: Provide shapes indicated and as follows:

1. Provide special shapes for lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners, unless indicated as bullnose.

B. Concrete Masonry Units: ASTM C90 and as follows:

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi (13.1 MPa)
2. Weight Classification: Normal weight.
3. Provide Type I, moisture-controlled units.
4. Size (Width): Manufactured to the following dimensions as indicated on the plans:

   a. 4 inches (102 mm) nominal; 3-5/8 inches (92 mm) actual.
   b. 8 inches (203 mm) nominal; 7-5/8 inches (194 mm) actual.
   c. 12 inches (305 mm) nominal; 11-5/8 inches (295 mm) actual.

5. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.

C. Decorative Concrete Masonry Units: ASTM C90 and as follows:

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi (13.1 MPa.
2. Weight Classification: Normal weight.
3. Provide Type I, moisture-controlled units.
4. Size: Manufactured to dimensions indicated for nondecorative units.
5. Finish: Exposed faces of the following general description matching color, pattern, and texture of Architect's samples.
   a. Normal-weight aggregate, split-face finish.

6. Integral Water Repellent: Provide units made with liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive according to ASTM E 514, with test period extended to 24 hours, show no visible water or leaks on the back of the test specimen.

   a. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   b. Products: Subject to compliance with requirements, provide one of the following:

      1) Block Plus W-10; Addiment Inc.
      2) Dry-Block; W. R. Grace & Co., Construction Products Division.
      3) Rheopel; Master Builders.

2.2 MORTAR AND GROUT MATERIALS

A. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207.

B. Aggregate for Mortar: ASTM C 144; except for joints less than 1/4 inch (6.5 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.

1. White-Mortar Aggregates: Natural white sand or ground white stone.
2. Colored-Mortar Aggregates: Natural-colored sand or ground marble, granite, or other sound stone; of color necessary to produce required mortar color.

C. Aggregate for Grout: ASTM C 404.

D. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by the manufacturer for use in masonry mortar of composition indicated.

E. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.

F. Water: Potable.

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

1. Colored Portland Cement-Lime Mix:

a. Eaglebond; Blue Circle Cement.
b. Color Mortar Blend; Glen-Gery Corporation.
c. Rainbow Mortamix Custom Color Cement/Lime; Holnam, Inc.
d. Centurion Colorbond PL; Lafarge Corporation.
e. Lehigh Custom Color Portland/Lime; Lehigh Portland Cement Co.
f. Riverton Portland Cement Lime Custom Color; Riverton Corporation (The).

2. Cold-Weather Admixture:

a. Accelguard 80; Euclid Chemical Co.
b. Morseled; W. R. Grace & Co., Construction Products Division.
c. Trimix-NCA; Sonneborn, Div. of ChemRex, Inc.

3. Water-Repellent Admixture:

a. Mortar Tite; Addiment Inc.
b. Dry-Block Mortar Admixture; W. R. Grace & Co., Construction Products Division.
c. Rheopel; Master Builders.

2.3 REINFORCING STEEL

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M; Grade 60.

2.4 MASONRY JOINT REINFORCEMENT

A. General: ASTM A951 and as follows:
1. Hot-dip galvanized, carbon-steel wire for both interior and exterior walls.
2. Wire Size for Side Rods: W1.7 or 0.148 inch (3.8 mm).
3. Wire Size for Cross Rods: W1.7 or 0.148 inch (3.8 mm).

4. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units where indicated.

B. For single-wythe masonry, provide either ladder or truss type with single pair of side rods and cross rods spaced not more than 16 inches (407 mm) o.c.

C. For multiwythe masonry, provide types as follows:

1. Ladder type with perpendicular cross rods spaced not more than 16 inches (407 mm) o.c. and 1 side rod for each face shell of hollow masonry units more than 4 inches (100 mm) in width, plus 1 side rod for each wythe of masonry 4 inches (100 mm) or less in width.
2. Tab type with single pair of side rods spaced for embedment within each face shell of backup wythe and rectangular box-type cross ties spaced not more than 16 inches (407 mm) o.c. Size ties to extend at least halfway through outer wythe but with at least 5/8-inch (16-mm) cover on outside face.

2.5 TIES AND ANCHORS, GENERAL

A. General: Provide ties and anchors, specified in subsequent articles, made from materials that comply with this Article, unless otherwise indicated.

B. Hot-Dip Galvanized Carbon-Steel Wire: ASTM A 82; with ASTM A 153, Class B-2 coating.

C. Steel Sheet, Galvanized after Fabrication: ASTM A 366/A 366M cold-rolled, carbon-steel sheet hot-dip galvanized after fabrication to comply with ASTM A 153.

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

2.6 BENT WIRE TIES

A. General: Rectangular units with closed ends and not less than 4 inches (100 mm) wide. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches (50 mm) long may be used for masonry constructed from solid units or hollow units laid with cells horizontal.

1. Where coursing between wythes does not align, use adjustable ties composed of 2 parts; 1 with pintles, the other with eyes; with maximum misalignment of 1-1/4 inches (32 mm).

B. Wire: Fabricate from 3/16 inch (4.8 mm) diameter, hot-dip galvanized steel wire.

2.7 ADJUSTABLE ANCHORS FOR CONNECTING TO STEEL FRAME

A. General: Provide two-piece assemblies that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section: Crimped 1/4-inch- (6.4-mm-) diameter, hot-dip galvanized steel wire anchor section for welding to steel.
2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.1875 inch (4.8 mm) diameter, hot-dip galvanized steel wire.

2.8 ADJUSTABLE MASONRY-VENEER ANCHORS

A. General: Provide two-piece assemblies that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:

1. Structural Performance Characteristics: Capable of withstanding a 100-lbf (445-N) load in both tension and compression without deforming or developing play in excess of 0.05 inch (1.3 mm).

B. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie section and a metal anchor section complying with the following requirements:

1. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, 2-3/4 inches (70 mm) wide by 3 inches (75 mm) high; with projecting tabs having slotted holes for inserting vertical legs of wire tie specially formed to fit anchor section.
2. Anchor Section: Sheet metal plate with screw holes top and bottom and with raised rib-stiffened strap stamped into center to provide a slot between strap and plate for connection of wire tie.
    a. Plate 1-1/4 inches (32 mm) wide by 6 inches (150 mm) long with strap 5/8 inch (16 mm) wide by 3-5/8 inches (92 mm) long; slot clearance formed between face of plate and back of strap shall not exceed diameter of wire tie by more than 1/32 inch (0.8 mm).
3. Wire Tie Section: Triangular or Rectangular shaped wire tie sized to extend at least halfway through veneer but with at least 5/8-inch (16-mm) cover on outside face.
4. Fabricate sheet metal anchor sections and other sheet metal parts from 0.0966 inch (2.5 mm), thisck, steel sheet, galvanized after fabrication.
5. Fabricate wire tie sections from 0.1875 inch (4.8 mm) diameter, hot-dip galvanized steel wire.

C. Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and neoprene washer, No. 10 (4.8-mm) diameter by length required to penetrate steel stud flange by not less than 3 exposed threads, and with the following corrosion protective coating:

1. Organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B 117.

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

1. Screw-Attached, Masonry-Veneer Anchors:
    a. D/A 213; Dur-O-Wal, Inc.
    b. D/A 210 with D/A 700-708; Dur-O-Wal, Inc.
    c. 315-D with 316; Heckman Building Products, Inc.
    d. Pos-I-Tie; Heckman Building Products, Inc.
    e. DW-10; Hohmann & Barnard, Inc.
    f. DW-10HS; Hohmann & Barnard, Inc.
    g. DW-10-X; Hohmann & Barnard, Inc.
    h. 1004, Type III; Masonry Reinforcing Corporation of America.
    i. RJ-711; Masonry Reinforcing Corporation of America.
2. Organic-Polymer-Coated, Steel Drill Screws:
    a. Dril-Flex; Elco Industries, Inc.
    b. Traxx; ITW-Buildex.

2.9 MISCELLANEOUS ANCHORS

A. Anchor Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of diameter and length indicated and in the following configurations:

1. Headed bolts.
2. Nonheaded bolts, bent in manner indicated.

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

2.10 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Fabricate from the following metal complying with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim" and below:

B. Solder and Sealants for Sheet Metal Flashings: As specified in Division 7 Section "Sheet Metal Flashing and Trim."

2.11 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: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

1. Styrene-Butadiene-Rubber Compound: ASTM D 2000, Designation M2AA-805.

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

D. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8-inch (9-mm) OD by 4 inches (100 mm) long.

E. Wicking Material: Cotton or polyester rope, 1/4 to 3/8 inch (6 to 10 mm) in diameter, in length required to produce 2-inch (50-mm) exposure on exterior and 18 inches (450 mm) in cavity between wythes.

F. Plastic Weep Hole/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, designed to fill head joint with outside face held back 1/8 inch (3 mm) from exterior face of masonry, in color selected from manufacturer's standard.

G. Cavity Drainage Material: ¾ inch (19 mm) thick, free-draining mesh; made from polyethylene strands and shaped to avoid being clogged by mortar droppings.

H. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142 inch (3.6 mm) steel wire, hot-dip galvanized after fabrication.

1. Provide units with either two loops or four loops as needed for number of bars indicated.

I. Available Products: Subject to compliance with requirements, cavity drainage materials that may be incorporated into the Work include, but are not limited to, the following:

1. Plastic Weep Hole/Vent:

a. Cell Vent; Dur-O-Wal, Inc.

2. Cavity Drainage Material:

a. Mortar Break; Advanced Building Products, Inc.
b. CavClear Masonry Mat; CavClear.
c. Mortar Net; Mortar Net USA, Ltd.
d. Mortar Stop; Polytite Manufacturing Corp.

3. Reinforcing Bar Positioners:

a. D/A 811; Dur-O-Wal, Inc.
b. No. 376 Rebar Positioner; Heckman Building Products, Inc.
c. #RB Rebar Positioner; Hohmann & Barnard, Inc.
d. O-Ring Rebar Positioner; Masonry Reinforcing Corporation of America.

2.12 MASONRY-CELL INSULATION

A. Molded-Polystyrene Insulation Units: Rigid, cellular thermal insulation formed by the expansion of polystyrene-resin beads or granules in a closed mold to comply with ASTM C 578, Type I. Provide specially shaped units designed for installing in cores of masonry units. Provide cell insulation in units as located in the architectural plans or specifications.

2.13 MASONRY CLEANERS

A. Job-Mixed Detergent Solution: Solution of 1/2-cup (0.14-L) dry measure tetrasodium polyphosphate and 1/2-cup (0.14-L) dry measure laundry detergent dissolved in 1 gal. (4 L) of water.

2.14 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 the same rate for all mortar, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in the 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 C270, Proportion Specification.
1. For masonry below grade, in contact with earth, and where indicated, use Type S.
2. For reinforced masonry and where indicated, use Type S.

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 5 of 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 (200 to 280 mm) as measured according to ASTM C 143.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

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

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual widths of masonry units, using units of widths indicated.

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

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

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

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

F. Wetting of Brick: Wet brick before laying if the initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at the time of laying.

3.3 CONSTRUCTION TOLERANCES

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

B. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch (12 mm) maximum.

C. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), nor 1/2 inch (12 mm) maximum.

D. For conspicuous horizontal lines, such as exposed lintels, sills, parapets, and reveals, do not vary from level by more than 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch (12 mm) maximum.

E. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm). Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).

F. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).

3.4 LAYING MASONRY WALLS

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

B. Bond Pattern for Exposed Masonry: Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

1. One-half running bond with vertical joint in each course centered on units in courses above and below.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches (50 mm). Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: In each course, rack back one-half-unit length for one-half running bond. Clean exposed surfaces of set masonry and remove loose masonry units and mortar before laying fresh masonry.

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

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

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

H. Fill cores in hollow concrete masonry units with grout for full height of wall under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow masonry units as follows:

1. With full mortar coverage on horizontal and vertical face shells.
2. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.

3. For starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells.

B. Lay solid brick-size 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.

1. At cavity walls, bevel beds away from cavity, to minimize mortar protrusions into cavity. As work progresses, trowel mortar fins protruding into cavity flat against the cavity face of the brick.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than the 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.

3.6 BONDING OF MULTIWYTHE MASONRY

A. Use masonry joint reinforcement installed in horizontal mortar joints to bond wythes together.

B. Corners: Provide interlocking masonry unit bond in each wythe and course at corners, unless otherwise indicated.

1. Provide continuity with masonry joint reinforcement at corners by using prefabricated "L" units as well as masonry bonding.

C. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:
1. Provide continuity with masonry joint reinforcement by using prefabricated "T" units.

3.7 CAVITIES

A. Keep cavities clean of mortar droppings and other materials during construction. Strike joints facing cavities flush.

1. Use wood strips temporarily placed in cavity to collect mortar droppings. As work progresses, remove strips, clean off mortar droppings, and replace in cavity.

3.8 MASONRY-CELL INSULATION

A. Install molded-polystyrene insulation units into masonry unit cells before laying units.

3.9 MASONRY JOINT REINFORCEMENT

A. General: Provide continuous masonry joint reinforcement as indicated. Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

1. Space reinforcement not more than 16 inches (406 mm) o.c.

B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at corners and wall intersections by using prefabricated "L" and "T" sections. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.10 ANCHORING MASONRY TO STRUCTURAL MEMBERS

A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

1. Provide an open space not less than 1 inch (25 mm) in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar or other rigid materials.
2. Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 16 inches (610 mm) o.c. vertically and 32 inches (915 mm) o.c. horizontally.

3.11 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:

1. Fasten each anchor section through sheathing to wall framing with two metal fasteners of type indicated.
2. Embed tie sections in masonry joints. Provide not less than 2 inches (50 mm) of air space between back of masonry veneer and face of sheathing.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 16 inches (406 mm) o.c. vertically and 32 inches (813 mm) o.c. horizontally with not less than 1 anchor for each 3.5 sq. ft. (0.33 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 36 inches (914 mm), around perimeter.

3.12 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joints in unit masonry as follows unless otherwise indicated on drawings. Build-in related items as masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.
1. Vertical control joins shall be spaced at maximum 20’-0” o.c. in any continuous run of wall.

B. Form control joints in concrete masonry as follows:

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 joints in exposed faces.
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 joint.
4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete.

3.13 LINTELS

A. Install steel lintels where indicated or as required to provide support above all openings as shown on the architectural, structural, mechanical, plumbing or electrical plans.

B. Provide masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.
   1. Provide prefabricated or built-in-place masonry lintels if required in the architectural plans. Use specially formed bond beam units with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

C. Provide minimum bearing of 8 inches (200 mm) at each jamb, unless otherwise indicated.

D. Fill cores in hollow concrete masonry units with grout for full height of wall under all lintels.

3.14 FLASHING, WEEP HOLES, 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. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Unless otherwise indicated, 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.

C. Install flashing as follows:
   1. At masonry-veneer walls, extend flashing from exterior face of veneer, through veneer, up face of sheathing at least 8 inches (200 mm), and behind air-infiltration barrier or building paper.
   2. At lintels and shelf angles, extend flashing a minimum of 4 inches (100 mm) into masonry at each end. At heads and sills, extend flashing 4 inches (100 mm) at ends and turn flashing up not less than 2 inches (50 mm) to form a pan.

D. Install weep holes in the head joints in exterior wythes of the first course of masonry immediately above embedded flashing and as follows:

   1. Use round plastic tubing, wicking material or plastic weep hole/vents to form weep holes.
   2. Use wicking material to form weep holes above flashing in brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
   3. Space weep holes formed from plastic tubing or wicking material 16 inches (400 mm) o.c.
   4. Place cavity drainage material immediately above flashing in cavities.

E. Trim wicking material used in weep holes flush with outside face of wall after mortar has set.

F. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.15 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores to support reinforced masonry elements during construction.

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

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

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.

1. Comply with requirements of ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.16 PARGING

A. Parge predampened masonry walls, where indicated, with Type S or Type N mortar applied in 2 uniform coats to a total thickness of 3/4 inch (19 mm). Scarify first parge coat to ensure full bond to subsequent coat.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot (3 mm per 300 mm). Form a wash at top of parging and a cove at bottom.

C. Damp-cure parging for at least 24 hours and protect the parging until cured.

3.17 REPAIRING, POINTING, AND CLEANING

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

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

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

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

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

3.18 MASONRY WASTE DISPOSAL

A. Recycling: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

END OF SECTION 04810

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural-steel materials.
2. Shrinkage-resistant grout.
3. Prefabricated building columns.
4. Shear stud connectors.

B. Related Requirements:

1. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
2. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other steel items not defined as structural steel.
3. Section 099113 "Exterior Painting" and/or Section 099123 "Interior Painting" for painting requirements.

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.3 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.

1.4 ACTION SUBMITTALS

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

B. 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.

C. Delegated Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, 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 materials, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Shop-Painting Applicator Qualifications: Qualified in accordance with AISC's Sophisticated Paint Endorsement P1 or to SSPC-QP 3.

D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

E. Preinstallation Conference: Conduct conference at Project site.

1.7 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 F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:

1. ANSI/AISC 303.
2. ANSI/AISC 341.
3. ANSI/AISC 360.
4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:
1. Fabricator's experienced steel detailer selects or completes connections in accordance with ANSI/AISC 303.

a. Select and complete connections using schematic details indicated and ANSI/AISC 360.
b. Use Load and Resistance Factor Design; data are given at factored-load level.

2. Design connections and final configuration of member reinforcement at connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer.

a. Use Load and Resistance Factor Design; data are given at factored-load level.

C. Moment Connections: Type FR, fully restrained.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992/A992M

B. Channels, Angles, M-Shapes, S-Shapes: ASTM A36/A36M

C. Plate and Bar: ASTM A36/A36M Retain "Corrosion-Resisting (Weathering) Structural-Steel Shapes, Plates, and Bars" Paragraph below for corrosion-resisting (weathering) structural steel and indicate locations on Drawings.

D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B structural tubing.

E. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.

1. Weight Class: Standard.
2. Finish: Black except where indicated to be galvanized.

F. Steel Castings: ASTM A216/A216M, Grade WCB, with supplementary requirement S11.

G. Steel Forgings: ASTM A668/A668M.

H. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1 (Type 8.8-1), compressible-washer type with plain finish.

B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490 (Grade A490M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F959/F959M, Type 490-1 (Type 10.9-1), compressible-washer type with plain finish.

C. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating.
2. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1 (Type 8.8-1), compressible-washer type with mechanically deposited zinc coating finish.

D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Plain.

E. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 RODS

A. Unheaded Anchor Rods: ASTM F1554, Grade 36 or ASTM F1554, Grade 55, weldable (whichever specified on Drawings).

1. Configuration: Straight or Hooked.
2. Nuts: ASTM A563 (ASTM A563M) hex carbon steel.
3. Plate Washers: ASTM A36/A36M carbon steel.
4. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
5. Finish: Plain or Hot-dip zinc coating, ASTM A153/A153M, Class C.

B. Headed Anchor Rods: ASTM F1554, Grade 36 or ASTM F1554, Grade 55, weldable (whichever specified on Drawings), straight.

1. Nuts: ASTM A563 (ASTM A563M) hex carbon steel.
2. Plate Washers: ASTM A36/A36M carbon steel.
3. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
4. Finish: Plain or Hot-dip zinc coating, ASTM A153/A153M, Class C.

C. Threaded Rods: ASTM A36/A36M or ASTM A572/A572M, Grade 50 (Grade 345).

1. Nuts: ASTM A63 (ASTM A563M) hex carbon steel.
2. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
3. Finish: Plain or Hot-dip zinc coating, ASTM A153/A153M, Class C.

2.5 FORGED-STEEL STRUCTURAL HARDWARE

A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.

B. Eye Bolts and Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1030.

C. Sleeve Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1018.

2.6 SLIDE BEARINGS

A. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint.

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

a. Amscot Structural Products Corp.
b. Fluorocarbon Company Limited.
c. GRM Custom Products.
d. R.J. Watson Bridge & Structural Engineered Systems.
e. Approved Equivalent.

2. Mating Surfaces: PTFE and PTFE.

3. Coefficient of Friction: Not more than 0.05.
4. Design Load: Not less than 5,000 psi (34 MPa).
5. Total Movement Capability: 2 inches (50 mm).

2.7 PRIMER

A. Steel Primer:
   1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

B. Galvanized-Steel Primer: MPI#26.

   1. Etching Cleaner: MPI#25, for galvanized steel.
   2. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.8 SHRINKAGE-RESISTANT GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.9 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

   1. Camber structural-steel members where indicated.
   2. Fabricate beams with rolling camber up.
   3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing 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 in accordance with SSPC-SP 1.

F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.

H. Welded-Steel Door Frames: Build up welded-steel doorframes attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches (250 mm) o.c. unless otherwise indicated on Drawings.

I. 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.

2.10 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength 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 and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.11 PREFABRICATED BUILDING COLUMNS

A. Prefabricated building columns, consisting of load-bearing structural-steel members protected by concrete fireproofing encased in an outer non-load-bearing steel shell.

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

a. Black Rock Fireproof Column, a division of United Steel.
b. Dean Lally LLC / FireTrol Columns.
c. Approved Equivalent.

B. Fire-Resistance Ratings: Provide prefabricated building column listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for ratings indicated, based on testing in accordance with ASTM E119.

1. Fire-Resistance Rating: As indicated on Drawings.

2.12 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.

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, shelf angles, and welded door frames attached to structural-steel frame and located in exterior walls.

2.13 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 (50 mm).
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. Corrosion-resisting (weathering) steel surfaces.
7. Surfaces enclosed in interior construction.

B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:

1. SSPC-SP 2.
2. SSPC-SP 3.
3. SSPC-SP 7 (WAB)/NACE WAB-4.
4. SSPC-SP 14 (WAB)/NACE WAB-8.
5. SSPC-SP 11.
6. SSPC-SP 6 (WAB)/NACE WAB-3.
7. SSPC-SP 10 (WAB)/NACE WAB-2.
8. SSPC-SP 5 (WAB)/NACE WAB-1.
9. SSPC-SP 8.

C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner.

D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

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

2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.14 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform shop tests and inspections.

1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
2. Bolted Connections: Inspect and test shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

    a. Liquid Penetrant Inspection: ASTM E165/E165M.
    b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
    c. Ultrasonic Inspection: ASTM E164.
    d. Radiographic Inspection: ASTM E94/E94M.

4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:

    a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
    b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.

5. Prepare test and inspection reports.

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 on Drawings.

1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

B. Baseplates, Bearing Plates, and Leveling Plates: 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 shrinkage-resistant 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 grouting.

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

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. Slope roof framing members to slopes indicated on Drawings.
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 Engineer. 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.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/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 ANSI/AISC 303 for mill material.

C. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.5 INSTALLATION OF PREFABRICATED BUILDING COLUMNS

A. Install prefabricated building columns to comply with ANSI/AISC 360, manufacturer's written recommendations, and requirements of testing and inspecting agency that apply to the fire-resistance rating indicated.

3.6 REPAIR

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.

B. Touchup Painting:

1. 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.

a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

2. Cleaning and touchup painting are specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting."

3.7 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a 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. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

    a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

        1) Liquid Penetrant Inspection: ASTM E165/E165M.
        2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
        3) Ultrasonic Inspection: ASTM E164.
        4) Radiographic Inspection: ASTM E94/E94M.

3. Shear Stud Connectors: 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:

    a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
    b. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

PART 4 - MEASUREMENT, QUANITTY & PAYMENT

Cost for work specified in this section shall be paid for under the bid form line items for which they are a part. Costs shall include all furnishment and installation of structural steel materials as required per the contract documents. This includes but is not limited to fabrication of structural steel girders and columns, all connections and anchors, priming and galvanizing as required, and erection of all structural steel.

END OF SECTION 051200

SECTION 052100 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. K-series steel joists.
2. K-series steel joist substitutes.
3. LH-series long-span steel joists.
4. DLH-series long-span steel joists.
5. CJ-series composite steel joists.
6. Steel joist girders.
7. Steel joist accessories.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing bearing plates in concrete.
2. Section 042000 "Unit Masonry" for installing bearing plates in unit masonry.
3. Section 051200 "Structural Steel Framing" for field-welded shear connectors.

1.2 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."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. 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.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Welding certificates.

C. Manufacturer certificates.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

E. Mill Certificates: For each type of bolt.

F. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

G. Field quality-control reports.

1.5 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."

1.6 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.

1.7 SEQUENCING

A. Deliver steel bearing plates to be built into cast-in-place concrete and masonry construction.

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. Canam Buildings US Inc.; Canam Group Inc.
2. Gooder-Henrichsen Co.
3. New Millennium Building Systems, LLC.
4. Structures of U.S.A., Inc.

5. Valley Joist.
6. Vulcraft/Verco Group; a division of Nucor Corp.
7. Approved Equivalent.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated on Drawings.

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. Floor Joists: Vertical deflection of 1/360 of the span.
    b. Roof Joists: Vertical deflection of 1/360 of the span.

2.3 STEEL JOISTS

A. K-Series Steel Joist: Manufactured steel joists of type indicated according to "Standard Specification 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.
2. K-Series Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
3. Provide holes in chord members for connecting and securing other construction to joists.
4. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated on Drawings, complying with SJI's "Specifications."
5. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated on Drawings, complying with SJI's "Specifications."
6. Do not camber joists.
7. Camber joists according to SJI's "Specifications."
8. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

B. Long-Span Steel Joist: Manufactured steel joists according to "Standard Specification for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as follows:

1. Joist Type: LH-series long-span steel joists and DLH-series long-span steel joists.
2. End Arrangement: Underslung.
3. Top-Chord Arrangement: Parallel.
4. Provide holes in chord members for connecting and securing other construction to joists.
5. Camber long-span steel joists according to SJI's "Specifications."
6. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

2.4 STEEL JOIST GIRDERS

A. Manufactured joist girders according to "Standard Specification for Joist Girders" in SJI's "Specifications," with steel-angle top- and bottom-chord members; with end and top-chord arrangements as follows:

1. End Arrangement: Underslung with bottom-chord extensions.
2. Top-Chord Arrangement: Parallel.
3. Provide holes in chord members for connecting and securing other construction to joist girders.
4. Camber joist girders according to SJI's "Specifications."
5. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

2.5 PRIMERS

A. Primer:

1. SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.6 STEEL JOIST ACCESSORIES

A. Bridging:

1. 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 A36/A36M steel with integral anchorages of sizes and thicknesses indicated on Drawings. 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.

1. Extend ends to within 1/2 inch (13 mm) of finished wall surface unless otherwise indicated on Drawings.
2. Finish: Plain, uncoated.

E. Welding Electrodes: Comply with AWS standards.

F. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

G. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.7 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.

B. 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 (0.025 mm) 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 of the Work.

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 instructions, 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 high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for high-strength structural bolt installation and tightening requirements.

E. 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 REPAIRS

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Touchup Painting:

1. Immediately after installation, clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists**,** bearing plates, abutting structural steel, and accessories.

a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
b. Apply a compatible primer of same type as primer used on adjacent surfaces.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Visually inspect field welds according to AWS D1.1/D1.1M.

C. Visually inspect bolted connections.

D. Prepare test and inspection reports.

PART 4 - MEASUREMENT, QUANITTY & PAYMENT

Cost for work specified in this section shall be paid for under the bid form line items for which they are a part. Costs shall include all furnishment and installation of steel joist framing as required per the contract documents. This includes but is not limited to fabrication of steel joist framing, all connections and anchors, all steel joist accessories, priming, and erection of all steel joist framing.

END OF SECTION 052100

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof deck.
2. Composite floor 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.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Roof deck.
2. Acoustical roof deck.
3. Composite floor deck.
4. Noncomposite form deck.
5. Noncomposite vented form deck.

B. 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.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

D. Qualification Statements: For welding personnel.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:

1. AWS D1.1/D1.1M.
2. AWS D1.3/D1.3M.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.

B. Fire-Resistance Ratings: Comply with ASTM E119; 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 listings of another qualified testing agency.

2.2 ROOF DECK

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

1. ASC Steel Deck; ASC Profiles, LLC.
2. CSM Metal Deck.
3. Canam Buildings US Inc.; Canam Group Inc.
4. Cordeck.
5. DACS, Inc.
6. Epic Metals Corporation.
7. Marlyn Steel Decks, Inc.
8. Miami Metal Deck.
9. New Millennium Building Systems, LLC.
10. OEG Building Materials Inc.

11. Roof Deck, Inc.
12. Tristate Decking, Inc.
13. Valley Joist.
14. Verco Decking, Inc.; a Nucor company.
15. Vulcraft Group; Division of Nucor Corp.
16. Approved Equivalent.

B. Fabrication of Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:

1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33 (230) G60 (Z180) zinc coating.
2. Deck Profile: As indicated on the plans.
3. Profile Depth: As indicated on the plans.
4. Design Uncoated-Steel Thickness: As indicated on the plans.
5. Span Condition: As indicated on the plans.
6. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 COMPOSITE FLOOR DECK

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

1. ASC Steel Deck; ASC Profiles, LLC.
2. CSM Metal Deck.
3. Canam Buildings US Inc.; Canam Group Inc.
4. Cordeck.
5. DACS, Inc.
6. Epic Metals Corporation.
7. Marlyn Steel Decks, Inc.
8. Miami Metal Deck.
9. New Millennium Building Systems, LLC.
10. OEG Building Materials Inc.
11. Roof Deck, Inc.
12. Tristate Decking, Inc.
13. Verco Decking, Inc.; a Nucor company.
14. Vulcraft Group; Division of Nucor Corp.
15. Approved Equivalent.

B. Fabrication of Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with SDI C, with the minimum section properties indicated, and with the following:
1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33 (230), G60 (Z180) zinc coating.
2. Profile Depth: As indicated on the plans.
3. Design Uncoated-Steel Thickness: As indicated on the plans.
4. Span Condition: As indicated on the plans.

2.4 ACCESSORIES

A. 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 (4.8-mm) 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 (230 MPa), not less than 0.0359-inch (0.91-mm) 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 (230 MPa), of same material and finish as deck, and of thickness and profile recommended by SDI standards 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. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

I. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch (1.90 mm) 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 (1.90 mm) thick, of same material and finish as deck, with 3-inch- (76-mm-) wide flanges and [level] [sloped] recessed pans of 1-1/2-inch (38-mm) minimum depth. For drains, cut holes in the field.

K. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

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 of the Work.

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

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; 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. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.3 INSTALLATION OF ROOF DECK

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 (38 mm) long, and as follows:

1. Weld Diameter: 5/8 inch (16 mm), 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 18 inches (460 mm) apart, maximum.
3. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 18 inches (460 mm), and as follows:

1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch.
3. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:

1. End Joints: Lapped 2 inches (50 mm) minimum].

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches (300 mm) apart with at least one weld at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and weld.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels in accordance with deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

3.4 INSTALLATION OF FLOOR DECK

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 (16 mm), nominal.
2. Weld Spacing:

   a. Weld edge ribs of panels at each support. Space additional welds an average of 16 inches (400 mm) apart, but not more than 18 inches (460 mm) apart.
   b. Space and locate welds as indicated.

3. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches (1 m), and as follows:

1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch.
3. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:

1. End Joints: Lapped.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure in accordance with SDI recommendations unless otherwise indicated.

E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, in accordance with SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.5 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.

B. Repair Painting:

1. Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation and apply repair paint.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.

    a. Field welds will be subject to inspection.

2. Steel decking will be considered defective if it does not pass tests and inspections.
3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:

    a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
    b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors that are already tested.

C. Prepare test and inspection reports.

PART 4 - MEASUREMENT, QUANTITY & PAYMENT

Cost for work specified in this section shall be paid for under the bid form line items for which they are a part. Costs shall include all furnishment and installation of all steel deck as required per the contract documents. This includes but is not limited to fabrication of steel roof and floor decking, all connections and anchors, priming and/or galvanizing as required, all steel decking accessories, and erection of all steel decking.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Load-bearing wall framing.
2. Exterior non-load-bearing wall framing.
3. Interior non-load-bearing wall framing.
4. Roof rafter framing.
5. Ceiling joist framing.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Cold-formed steel framing materials.
2. Load-bearing wall framing.
3. Exterior non-load-bearing wall framing.
4. Interior non-load-bearing wall framing.
5. Vertical deflection clips.
6. Single deflection track.
7. Double deflection track.
8. Drift clips.
9. Floor joist framing.
10. Roof-rafter framing.
11. Ceiling joist framing.
12. Soffit framing.
13. Post-installed anchors.
14. Power-actuated anchors.
15. Sill sealer gasket.
16. Sill sealer gasket/termite barrier.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated Design Submittal: For cold-formed steel trusses.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of code-compliance certification for studs and tracks.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association.

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

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

E. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI S202.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. AllSteel & Gypsum Products, Inc.

2. CEMCO; California Expanded Metal Products Co.
3. ClarkDietrich.
4. Consolidated Fabricators Corp.; Building Products Division.
5. Craco Manufacturing, Inc.
6. Custom Stud.
7. Design Shapes in Steel.
8. Formetal Co. Inc. (The).
9. Jaimes Industries.
10. MBA Building Supplies.
11. MRI Steel Framing, LLC.
12. Marino\WARE.
13. Mill Steel Framing; Mill Steel Company.
14. Olmar Supply, Inc.
15. Quail Run Building Materials, Inc.
16. SCAFCO Steel Stud Company; Stone Group of Companies.
17. Southeastern Stud & Components, Inc.
18. State Building Products, Inc.
19. Steel Construction Systems; Stone Group of Companies.
20. Steel Network, Inc. (The).
21. Steeler, Inc.
22. Super Stud Building Products Inc.
23. Telling Industries.
24. The Mill Steel Co.
25. United Metal Products, Inc.
26. United Steel Deck, Inc.
27. Approved Equivalent.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel truss framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated on Drawings.
2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:

    a. Exterior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height.
    b. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft. (239 Pa).
    c. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height.
    d. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft. (239 Pa).
    e. Floor Joist Framing: Vertical deflection of 1/360 for live loads and l/240 for total loads of the span.
    f. Roof Rafter Framing: Vertical deflection of 1/360 of the horizontally projected span for live loads.

g. Ceiling Joist Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.

3. Design framing systems to provide for movement of framing members located outside the insulated building envelope 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 (67 deg C).
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 1/2 inch (13 mm).

5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing complies with AISI S100 and AISI S240.

D. Fire-Resistance Ratings: Comply with ASTM E119; 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 acceptable to authorities having jurisdiction.

2.3 COLD-FORMED STEEL FRAMING MATERIALS

A. Framing Members, General: Comply with AISI S240 for conditions indicated.

B. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: ST33H (ST230H).
2. Coating: G90 (Z275) or equivalent.

C. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: 50 (340), Class 1.
2. Coating: G90 (Z275).

2.4 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
2. Flange Width: 1-3/8 inches (35 mm).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches (32 mm).

C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
2. Flange Width: 1-3/8 inches (35 mm).

2.5 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
2. Flange Width: 1-3/8 inches (35 mm).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches (32 mm).

C. Vertical Deflection Clips, Exterior: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. 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 loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
2. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures and 1 inch (25 mm) plus twice the design gap for other applications.

E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.6 INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
2. Flange Width: 1-3/8 inches (35 mm).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches (32 mm).

C. 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 loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
2. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures and 1 inch (25 mm) plus twice the design gap for other applications].

2.7 ROOF-RAFTER FRAMING

A. Steel Rafters: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
2. Flange Width: 1-5/8 inches (41 mm), minimum.

2.8 CEILING JOIST FRAMING

A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, unpunched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
2. Flange Width: 1-5/8 inches (41 mm), minimum.

2.9 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole-reinforcing plates.

11. Backer plates.

2.10 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Anchor Bolts: ASTM F1554, 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 A153/A153M, Class C.

C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.

1. Uses: Securing cold-formed steel framing to structure.

D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.11 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20.

B. Cement Grout: Portland cement, ASTM C150/C150M, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.

D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

E. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch (6 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

2.12 FABRICATION

A. Fabricate cold-formed steel 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 steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M 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 screws penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.

C. Tolerances: Fabricate assemblies' level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, conditions, and abutting structural framing 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. 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 required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

C. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. 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 (1.6 mm).

D. Install cold-formed steel 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 steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads equal 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.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 INSTALLATION OF LOAD-BEARING WALL FRAMING

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:

1. Anchor Spacing: 24 inches (610 mm).

B. Squarely seat studs against top and bottom tracks, with gap not exceeding 1/8 inch (3 mm) between the end of wall-framing member and the web of track.

1. Fasten both flanges of studs to top and bottom tracks.
2. Space studs as follows:

a. Stud Spacing: 16 inches (406 mm).

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.

1. Frame wall openings with not less than a double stud at each jamb of frame. Fasten jamb members together to uniformly distribute loads.
2. Install tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.

1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced vertically 48 inches (1220 mm). Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches (150 mm) deep.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges, and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

J. Install steel sheet diagonal bracing straps to both stud flanges; terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.

K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INSTALLATION OF EXTERIOR NONLOADBEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 16 inches (406 mm).

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Connect vertical deflection clips to bypassing studs and anchor to building structure.
3. Connect drift clips to cold-formed steel framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

1. Install solid blocking at 96-inch (2440-mm) centers.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 INSTALLATION OF INTERIOR NONLOADBEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 16 inches (406 mm).

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Connect vertical deflection clips to studs and anchor to building structure.
3. Connect drift clips to cold-formed steel metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

1. Install solid blocking at 96-inch (2440-mm) centers.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.7 INSTALLATION OF JOIST FRAMING

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.

1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm).
2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections.

C. Space joists not more than 2 inches (51 mm) from abutting walls, and as follows:

1. Joist Spacing: 12 inches (305 mm).

D. Frame openings with built-up joist headers, consisting of joist and joist track or another combination of connected joists if indicated.

E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement.

1. Install web stiffeners to transfer axial loads of walls above.

F. Install bridging at intervals indicated. Fasten bridging at each joist intersection as follows:

1. Joist-Track Solid Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
2. Combination Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated, and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.8 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error is not to exceed minimum fastening requirements of sheathing or other finishing materials.

3.9 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.10 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.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.11 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

PART 4 - MEASUREMENT, QUANITTY & PAYMENT

Cost for work specified in this section shall be paid for under the bid form line items for which they are a part. Costs shall include all furnishment and installation of cold-formed metal framing materials as required per the contract documents. This includes but is not limited to fabrication/installation of cold-formed metal wall and ceiling framing and accessories, along with anchors/clips/fasteners.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous framing and supports.
2. Prefabricated building columns.
3. Shelf angles.
4. Metal ladders.
5. Alternating tread devices.
6. Metal ships' ladders and pipe crossovers.
7. Metal floor plate.
8. Elevator pit sump covers.
9. Structural-steel door frames.
10. Miscellaneous steel trim.
11. Metal bollards.
12. Vehicular barrier cable systems.
13. Pipe and downspout guards.
14. Abrasive metal nosings, treads, and thresholds.
15. Cast-iron wheel guards.
16. Metal downspout boots.
17. Loose bearing and leveling plates.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
3. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

C. Related Requirements:

1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
2. Section 051200 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.

1.2 COORDINATION

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

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

1.3 ACTION SUBMITTALS

A. Product Data:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Fasteners.
3. Shop primers.
4. Shrinkage-resisting grout.
5. Prefabricated building columns.
6. Slotted channel framing.
7. Manufactured metal ladders.
8. Alternating tread devices.
9. Metal ships' ladders and pipe crossovers.
10. Metal bollards.
11. Vehicular barrier cable systems.
12. Pipe and downspout guards.
13. Abrasive metal nosings, treads, and thresholds.
14. Cast-iron wheel guards.
15. Metal downspout boots.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Miscellaneous framing and supports for applications where framing and supports are not specified in other Sections.
2. Elevator machine beams, hoist beams, and divider beams.
3. Steel shapes for supporting elevator door sills.
4. Steel girders for supporting wood frame construction.
5. Steel pipe columns for supporting wood frame construction.
6. Prefabricated building columns.
7. Shelf angles.
8. Metal ladders.
9. Alternating tread devices.
10. Metal ships' ladders and pipe crossovers.
11. Metal floor plate and supports.
12. Elevator pit sump covers.
13. Structural-steel door frames.
14. Miscellaneous steel trim including steel angle corner guards, steel edgings and loading-dock edge angles.
15. Metal bollards.
16. Loose steel lintels.
17. Vehicular barrier cable systems.

C. Delegated Design Submittals: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Research Reports: For post-installed anchors.

E. Delegated design engineer qualifications.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance of Aluminum Ladders: Ladders, including landings, are to withstand the effects of loads and stresses within limits and under conditions specified in ANSI/ASC A14.3.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304.

D. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.

E. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

F. Rolled-Stainless Steel Floor Plate: ASTM A793.

G. Abrasive-Surface Floor Plate: Steel plate with abrasive granules rolled into surface or with abrasive material metallically bonded to steel.

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

a. IKG.
b. Ohio Gratings, Inc.
c. SlipNOT Metal Safety Flooring, division of Traction Technologies Holdings, LLC.
d. Approved Equivalent.

2. Source Limitations: Obtain floor plate from single source from single manufacturer.

H. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

I. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

J. Zinc-Coated Steel Wire Rope: ASTM A741.

1. Wire Rope Fittings: Hot-dip galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.

K. Stainless Steel Wire Rope: Wire rope manufactured from stainless steel wire complying with ASTM A492, Type 316.

1. Wire Rope Fittings: Stainless steel connectors, Type 316, with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.

L. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: As indicated.
2. Galvanized Steel: ASTM A653/A653M, structural steel, Grade 33 (Grade 230), with G90 (Z275) coating; 0.064-inch (1.6-mm) nominal thickness.
3. Cold-Rolled Steel: ASTM A1008/A1008M, structural steel, Grade 33 (Grade 230); 0.0677-inch (1.7-mm) minimum thickness; hot-dip galvanized after fabrication.

M. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

N. Aluminum Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 6061-T6.

O. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T6.

P. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.

Q. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

R. Bronze Extrusions: ASTM B455, Alloy UNS No. C38500 (extruded architectural bronze).

S. Bronze Castings: ASTM B584, Alloy UNS No. C83600 (leaded red brass) or UNS No. C84400 (leaded semired brass).

T. Nickel Silver Extrusions: ASTM B151/B151M, Alloy UNS No. C74500.

U. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless steel fasteners for fastening aluminum, stainless steel or nickel silver.
2. Provide bronze fasteners for fastening bronze.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ISO 898-1, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, (ASTM A563M, Class 10S3) heavy-hex carbon-steel nuts; and where indicated, flat washers.

D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593 (ISO 3506-1); with hex nuts, ASTM F594 (ASTM F836M); and, where indicated, flat washers; Alloy Group 1 (A1).

E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

G. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.

H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 (ISO 3506-1), and nuts, ASTM F594 (ASTM F836M).

I. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer that contains pigments that make it easily distinguishable from zinc-rich primer.

B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

E. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

F. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 4000 psi (27 MPa).

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

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

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Fabricate supports for operable partitions from continuous steel beams of sizes recommended by partition manufacturer with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.

1. Provide bearing plates welded to beams where indicated.
2. Drill or punch girders and plates for field-bolted connections where indicated.
3. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at 24 inches (600 mm) o.c.

E. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.

1. Unless otherwise indicated, fabricate from Schedule 40 steel pipe.
2. Unless otherwise indicated, provide 1/2-inch (12.7-mm) baseplates with four 5/8-inch (16-mm) anchor bolts and 1/4-inch (6.4-mm) top plates.

F. Galvanize miscellaneous framing and supports where indicated.

2.7 PREFABRICATED BUILDING COLUMNS

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

1. Black Rock Fireproof Column, a division of United Steel.
2. Dean Lally LLC / FireTrol Columns.
3. Approved Equivalent.

B. Source Limitations: Obtain prefabricated building column from single source from single manufacturer.

C. General: Provide prefabricated building columns consisting of load-bearing structural-steel members protected by concrete fireproofing encased in an outer non-load-bearing steel shell. Fabricate connections to comply with details shown or as needed to suit type of structure indicated.

D. Fire-Resistance Ratings: Provide prefabricated building columns listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for ratings indicated, based on testing in accordance with ASTM E119.

1. Fire-Resistance Rating: As indicated.

2.8 SHELF ANGLES

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

1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Galvanize shelf angles located in exterior walls.

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

2.9 METAL LADDERS

A. General:

1. Comply with ANSI A14.3, except for elevator pit ladders.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders:

1. Space siderails 18 inches (457 mm) apart unless otherwise indicated.
2. Siderails: Continuous, 3/8-by-2-1/2-inch (9.5-by-64-mm) steel flat bars, with eased edges.
3. Rungs: 3/4-inch- (19-mm-) diameter or 3/4-inch- (19-mm-) square, steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Nonslip Surfaces for Steel Ladders: Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.

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

        1) IKG.
        2) SlipNOT Metal Safety Flooring, division of Traction Technologies Holdings, LLC.
        3) Approved Equivalent.

7. Source Limitations: Obtain nonslip surfaces from single source from single manufacturer.
8. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 3/4 inch (19 mm) in least dimension.
9. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.
10. Galvanize exterior ladders, including brackets.

C. Aluminum Ladders:

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

    a. Fixfast USA.

b. Halliday Products.
c. O'Keeffe's Inc.
d. Precision Ladders, LLC.
e. Royalite Manufacturing, Inc.
f. Thompson Fabricating, LLC.
g. UPNOVR, Inc.
h. Approved Equivalent.

2. Source Limitations: Obtain aluminum ladders from single source from single manufacturer.
3. Space siderails 18 inches (457 mm) apart unless otherwise indicated.
4. Siderails: Continuous extruded-aluminum channels or tubes, not less than 2-1/2 inches (64 mm) deep, 3/4 inch (19 mm) wide, and 1/8 inch (3.2 mm) thick.
5. Rungs: Extruded-aluminum tubes, not less than 3/4 inch (19 mm) deep and not less than 1/8 inch (3.2 mm) thick, with ribbed tread surfaces.
6. Fit rungs in centerline of siderails; fasten by welding or with stainless steel fasteners or brackets and aluminum rivets.
7. Provide platforms as indicated fabricated from pressure-locked aluminum bar grating or extruded-aluminum plank grating, supported by extruded-aluminum framing. Limit openings in gratings to no more than 3/4 inch (19 mm) in least dimension.
8. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c.]with welded or bolted aluminum brackets.
9. Provide minimum 72-inch- (1830-mm-) high, hinged security door with padlock hasp at foot of ladder to prevent unauthorized ladder use.

2.10 METAL SHIPS' LADDERS AND PIPE CROSSOVERS

A. Provide metal ships' ladders and pipe crossovers where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.

1. Treads are not to be less than 5 inches (127 mm) exclusive of nosing or less than 8-1/2 inches (216 mm) including the nosing, and riser height is not to be more than 9-1/2 inches (241 mm).
2. Fabricate ships' ladders and pipe crossovers, including railings from steel, stainless steel or aluminum, as indicated on the Contract Drawings.
3. Fabricate treads and platforms from welded or pressure-locked steel bar, pressure-locked stainless steel bar, pressure-locked aluminum bar or extruded-aluminum plank grating, as indicated on the Contract Drawings. Limit openings in gratings to no more than 3/4 inch (19 mm) in least dimension.
4. Fabricate treads and platforms from rolled-steel floor, rolled-stainless steel floor, rolled-aluminum-alloy tread or abrasive-surface floor plate, as indicated on the Contract Drawings.

B. Galvanize exterior steel ships' ladders and pipe crossovers, including treads, railings, brackets, and fasteners.

2.11 METAL FLOOR PLATE

A. Fabricate from rolled-steel floor, rolled-stainless steel floor, rolled-aluminum-alloy tread or abrasive-surface floor plate of thickness indicated below:

1. Thickness: As indicated.

B. Provide grating sections where indicated, fabricated from welded or pressure-locked steel bar, pressure-locked stainless steel bar, pressure-locked aluminum bar or extruded-aluminum plank grating. Limit openings in gratings to no more than 3/4 inch (19 mm) in least dimension.

C. Provide steel, stainless steel or aluminum angle supports as indicated.

D. Include steel, stainless steel or aluminum angle stiffeners, and fixed and removable sections as indicated.

E. Provide flush steel, stainless steel or aluminum bar drop handles for lifting removable sections, one at each end of each section.

2.12 ELEVATOR PIT SUMP COVERS

A. Fabricate from 3/16-inch (4.8-mm) rolled-steel floor plate with four 1-inch- (25-mm-) diameter holes for water drainage and for lifting.

B. Provide steel angle supports unless otherwise indicated.

2.13 STRUCTURAL-STEEL DOOR FRAMES

A. Fabricate structural-steel door frames from steel shapes, plates, and bars of size and to dimensions indicated, fully welded together, with 5/8-by-1-1/2-inch (16-by-38-mm) steel channel 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 (250 mm) o.c. Reinforce frames and drill and tap as necessary to accept finish hardware.

1. Provide with integrally welded steel strap anchors for securing door frames into adjoining concrete or masonry.

B. 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.

C. Galvanize exterior steel frames.

2.14 MISCELLANEOUS STEEL TRIM

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

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize exterior miscellaneous steel trim.

2.15 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 80 steel pipe or steel shapes, as indicated.

1. Cap bollards with 1/4-inch-(6.4-mm-) thick, steel plate with flat top.
2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.

B. Fabricate bollards with 3/8-inch-(9.5-mm-) thick, steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch (19-mm) anchor bolts.

1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.

C. Fabricate sleeves for bollard anchorage from steel or stainless steel pipe or tubing with 1/4-inch-(6.4-mm-) thick, steel or stainless steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard.

D. Fabricate internal sleeves for removable bollards from Schedule 80 **steel** pipe or 1/4-inch (6.4-mm) wall-thickness steel tubing with an OD approximately 1/16 inch (1.5 mm) less than ID of bollards. Match drill sleeve and bollard for 3/4-inch (19-mm) steel] machine bolt.

E. Prime steel bollards with zinc-rich primer.

2.16 PIPE AND DOWNSPOUT GUARDS

A. Fabricate pipe and downspout guards from 3/8-inch- (9.5-mm-) thick by 12-inch- (300-mm-) wide, steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 2-inch (50-mm) clearance between pipe and pipe guard. Drill each end for two 3/4-inch (19-mm) anchor bolts.

B. Galvanize steel pipe and downspout guards.

2.17 ABRASIVE METAL NOSINGS, TREADS, AND THRESHOLDS

A. Cast-Metal Units: Cast iron or aluminum, with an integral-abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.

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

    a. American Safety Tread Co., Inc.
    b. Balco; a CSW Industrials Company.
    c. Barry Pattern & Foundry Co., Inc.
    d. Safe-T-Metal Company, Inc.
    e. Wooster Products Inc.
    f. Approved Equivalent.

2. Source Limitations: Obtain units from single source from single manufacturer.
3. Cross-hatched nosings, 4 inches (100 mm) wide, with 1/4-inch- (6-mm-) thick 1-inch (25-mm) lip, for casting into concrete.
4. Cross-hatched nosings, 1-1/2 inches (38-mm) wide, 3/8-inch- (9.5-mm-) thick 1-1/2 inch (38-mm) lip, for casting into concrete.
5. Cross-hatched Treads: Full depth of tread with 3/4-by-3/4-inch (19-by-19-mm) nosing, for application over bent plate treads or existing stairs.
6. Fluted-Saddle-Type Thresholds: 5 inches (125 mm) wide by 1/2 inch (12 mm) high, with tapered edges.
7. Fluted-Interlocking or -Hook-Strip Thresholds: 5 inches (125 mm) wide by 5/8 inch (16 mm) high, with tapered edge.
8. Thresholds: Plain-stepped- (stop-) type units, 5 inches (125 mm) wide by 1/2 inch (12 mm) high, with 1/2-inch (12-mm) step.

B. Extruded Units: Aluminum, with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.

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

    a. American Safety Tread Co., Inc.
    b. Amstep Products.
    c. Armstrong Products, Inc.
    d. Balco; a CSW Industrials Company.
    e. Nystrom, Inc.
    f. Wooster Products Inc.
    g. Approved Equivalent.

2. Source Limitations: Obtain units from single source from single manufacturer.
3. Provide ribbed units, with abrasive filler strips projecting 1/16 inch (1.5 mm) above aluminum extrusion.
4. Nosings:

    a. Square-back units, 1-7/8 inches (48 mm) or 3 inches (75 mm) wide, for casting into concrete steps.
    b. Beveled-back units, 3 inches (75 mm) wide with 1-3/8-inch (35-mm) lip, for surface mounting on existing stairs.
    c. Two-piece units, 3 inches (75 mm) wide, with subchannel for casting into concrete steps.

5. Treads: Beveled-back units, full depth of tread with 1-3/8-inch (35-mm) lip, for application over existing stairs.

C. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

D. Apply bituminous paint to concealed surfaces of cast-metal units.

E. Apply clear lacquer to concealed surfaces of extruded units.

2.18 CAST-IRON WHEEL GUARDS

A. Provide wheel guards made from cast-iron, 3/4-inch- (19-mm-) thick, hollow-core construction, of size and shape indicated. Provide holes for countersunk anchor bolts and grouting.

2.19 METAL DOWNSPOUT BOOTS

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

1. J.R. Hoe & Sons Inc.
2. Neenah Foundry Company.
3. Approved Equivalent.

B. Source Limitations: Obtain downspout boots from single source from single manufacturer.

C. Provide downspout boots made from cast aluminum in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.

1. Outlet: Vertical, to discharge into pipe or at 35 degrees from horizontal, to discharge onto splash block or pavement.

2.20 LOOSE BEARING AND LEVELING PLATES

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

B. Galvanize bearing and leveling plates.

2.21 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches (200 mm) unless otherwise indicated.

C. Galvanize loose steel lintels located in exterior walls.

2.22 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.23 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.24 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
5. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

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

2.25 ALUMINUM FINISHES

A. As-Fabricated Finish: AA-M12.

B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

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

C. Field Welding: Comply with the following requirements:

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

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

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

F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

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

B. Anchor supports for ceiling-hung toilet partitions, operable partitions and overhead doors securely to, and rigidly brace from, building structure.

C. Anchor shelf angles securely to existing construction with expansion anchors or anchor bolts through bolts.

D. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

E. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installation of Bearing and Leveling Plates" Article.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLATION OF PREFABRICATED BUILDING COLUMNS

A. Install prefabricated building columns to comply with ANSI/AISC 360, "Specifications for Structural Steel Buildings," and with requirements applicable to listing and labeling for fire-resistance rating indicated.

3.4 INSTALLATION OF SHELF ANGLES

A. Install shelf angles as required to keep masonry level, at correct elevation, and flush with vertical plane.

3.5 INSTALLATION OF METAL LADDERS

A. Secure ladders to adjacent construction with the clip angles attached to the stringer.

B. Install brackets as required for securing of ladders welded or bolted to structural steel or built into masonry or concrete.

3.6 INSTALLATION OF ALTERNATING TREAD DEVICES

A. Secure top and bottom of alternating tread devices to construction to comply with manufacturer's written instructions.

3.7 INSTALLATION OF METAL SHIPS' LADDERS AND PIPE CROSSOVERS

A. Secure top and bottom of ships' ladders to construction to comply with manufacturer's written instructions.

B. Secure pipe crossovers to construction to comply with manufacturer's written instructions.

3.8 INSTALLATION OF METAL FLOOR PLATE

A. Install metal floor plates flush with finished surface. Adjust as required to avoid lippage that could present a tripping hazard.

3.9 INSTALLATION OF ELEVATOR PIT SUMP COVERS

A. Install tops of elevator sump pit cover plates and frames flush with finished surface. Adjust as required to avoid lippage that could present a tripping hazard.

3.10 INSTALLATION OF STRUCTURAL-STEEL DOOR FRAMES

A. Fasten structural steel door frames to the floor slab by means of angle clips and expansion bolts. Anchor door jambs to adjacent construction in accordance with shop drawing details.

3.11 INSTALLATION OF MISCELLANEOUS STEEL TRIM

A. Anchor to concrete construction to comply with manufacturer's written instructions.

3.12 INSTALLATION OF METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

1. Do not fill removable bollards with concrete.

B. Anchor bollards to existing construction with expansion anchors or anchor bolts. Provide four 3/4-inch (19-mm) bolts at each bollard unless otherwise indicated.

1. Embed anchor bolts at least 4 inches (100 mm) in concrete.

C. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. Fill annular space around bollard solidly with shrinkage-resistant grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward bollard.

D. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

E. Anchor internal sleeves for removable bollards in concrete by inserting in pipe sleeves preset into concrete. Fill annular space around internal sleeves solidly with shrinkage-resistant grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward internal sleeve.

F. Anchor internal sleeves for removable bollards in place with concrete footings. Center and align sleeves in holes 3 inches (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace sleeves in position until concrete has cured.

G. Place removable bollards over internal sleeves and secure with 3/4-inch (19-mm) machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner furnishes padlocks.

H. Fill bollards solidly with concrete, mounding top surface to shed water.

1. Do not fill removable bollards with concrete.

3.13 INSTALLATION OF PIPE AND DOWNSPOUT GUARDS

A. Provide pipe guards at exposed vertical pipes in parking garages where not protected by curbs or other barriers. Install by bolting to wall or column with expansion anchors. Provide four 3/4-inch (19-mm) bolts at each pipe guard. Mount pipe guards with top edge 26 inches (660 mm) above driving surface.

3.14 INSTALLATION OF ABRASIVE METAL NOSINGS, TREADS, AND THRESHOLDS

A. Center nosings on tread widths unless otherwise indicated.

B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.

C. Seal thresholds exposed to exterior with elastomeric sealant complying with Section 079200 "Joint Sealants" to provide a watertight installation.

3.15 INSTALLATION OF CAST-IRON WHEEL GUARDS

A. Anchor wheel guards to concrete or masonry construction to comply with manufacturer's written instructions. Fill cores solidly with concrete.

3.16 INSTALLATION OF METAL DOWNSPOUT BOOTS

A. Anchor metal downspout boots to concrete or masonry construction to comply with manufacturer's written instructions.

B. Secure downspouts terminations to downspouts and substrate per manufacturer's instructions.

3.17 INSTALLATION OF LOOSE BEARING AND LEVELING PLATES

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

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.18 REPAIRS

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

PART 4 - MEASUREMENT, QUANITTY & PAYMENT

Cost for work specified in this section shall be paid for under the bid form line items for which they are a part. Costs shall include all furnishment and installation of miscellaneous metal fabrications as required per the contract documents. This includes but is not limited to all metal materials fasteners, miscellaneous framing/supports, prefabricated building columns, shelf angles, metal ladders, metal floor plates, elevator sump pit covers, structural steel door frames, metal trim, metal bollards, pipe/downspout guards, abrasive metal treads, metal downspout boots, loose steel lintels, and all metal finishes.

END OF SECTION 055000

SECTION 055100

METAL STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preassembled steel stairs with concrete-filled treads.
2. Steel tube railings attached to metal stairs.
3. Steel tube handrails attached to walls adjacent to metal stairs.

B. See Division 05 Section "Pipe and Tube Railings" for pipe and tube railings not attached to metal stairs or to walls adjacent to metal stairs.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/240 or 1/4 inch (6.4 mm), whichever is less.

C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Infill load and other loads need not be assumed to act concurrently.

D. Seismic Performance: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor is 1.5.

1.3 SUBMITTALS

A. Product Data: For metal stairs.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified New Jersey professional engineer responsible for their preparation.

1.4 QUALITY ASSURANCE

A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.

1. Preassembled Stairs: Commercial class.
2. Industrial-Type Stairs: Industrial class.

PART 2 - PRODUCTS

2.1 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

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

C. Steel Tubing: ASTM A 500 (cold formed).

D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

E. Steel Bars for Grating Treads: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.

F. Wire Rod for Grating Crossbars: ASTM A 510 (ASTM A 510M).

G. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

H. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.

I. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.

J. Expanded-Metal, Carbon Steel: ASTM F 1267, Type I (expanded).

1. Style Designation: 3/4 number 13.

K. Woven-Wire Mesh: Intermediate-crimp, diamond pattern, 2-inch (50-mm) woven-wire mesh, made from 0.135-inch (3.5-mm) nominal diameter wire complying with ASTM A 510 (ASTM A 510M).

L. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

2.2 MISCELLANEOUS MATERIALS

A. Cast-Metal Units: Cast iron, with an integral abrasive, as-cast finish.

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

a. American Safety Tread Co., Inc.
b. Balco Inc.
c. Barry Pattern & Foundry Co., Inc.
d. Granite State Casting Co.
e. Safe-T-Metal Company, Inc.
f. Wooster Products Inc.

B. Extruded Units: Aluminum units with abrasive filler in an epoxy-resin binder.

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. ACL Industries, Inc.
b. American Safety Tread Co., Inc.
c. Amstep Products.
d. Armstrong Products, Inc.
e. Balco Inc.
f. Granite State Casting Co.
g. Wooster Products Inc.

2. Provide ribbed units, with abrasive filler strips projecting 1/16 inch (1.5 mm) above aluminum extrusion.
3. Provide solid-abrasive-type units without ribs.

C. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

D. Apply bituminous paint to concealed surfaces of cast-metal units set into concrete.

E. Apply clear lacquer to concealed surfaces of extruded units set into concrete.

F. Fasteners: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

G. Shop Primers: Provide primers that comply with Division 09 painting Sections.

H. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

I. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

J. Concrete Materials and Properties: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa) unless otherwise indicated.

K. Welded Wire Fabric: ASTM A 185/A 185M, 6 by 6 inches (152 by 152 mm), W1.4 by W1.4, unless otherwise indicated.

L. Precast Concrete Treads: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, ready-mixed concrete with a minimum 28-day compressive strength of 5000 psi (35 MPa) and a total air content of not less than 4 percent or more than 6 percent. Reinforce with galvanized, welded wire fabric, 2 by 2 inches (50 by 50 mm) by 0.062-inch- (1.6-mm-) diameter wire; comply with ASTM A 185/A 185M and ASTM A 82/A 82M, except for minimum wire size.

2.3 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.
3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.

B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without impairing work.

E. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: completely sanded joint, some undercutting and pinholes okay

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.

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

2.4 STEEL-FRAMED STAIRS

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. Alfab, Inc.
2. American Stair, Inc.
3. Sharon Companies Ltd. (The).

B. Stair Framing:

1. Fabricate stringers of steel channels.
2. Construct platforms of steel channel headers and miscellaneous framing members as needed to comply with performance requirements.
3. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below.
5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.067 inch (1.7 mm).

1. At Contractor's option, provide stair assemblies with metal-pan subtreads filled with reinforced concrete during fabrication.
2. Provide epoxy-resin-filled treads, reinforced with glass fibers, with slip-resistant, abrasive surface.

D. Abrasive-Coating-Finished, Formed-Metal Stairs: Form risers, treads, and platforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.097 inch (2.5 mm). Finish tread and platform surfaces with manufacturer's standard epoxy-bonded abrasive finish.

E. Metal Floor Plate Stairs: Form treads and platforms to configurations shown from rolled-steel floor plate of thickness[needed to comply with performance requirements, but not less than 1/4 inch (6.4 mm). Form treads with integral nosing and back edge stiffener. Weld steel supporting brackets to stringers and weld treads to brackets.

F. Metal Bar-Grating Stairs: Comply with NAAMM MBG 531, "Metal Bar Grating Manual."

1. Fabricate treads and platforms from steel grating with 1-by-3/16-inch (25-by-5-mm) bearing bars at 11/16 inch (17 mm) o.c and crossbars at 4 inches (100 mm) o.c.
2. Fabricate grating treads with rolled-steel floor plate nosing and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.

2.5 STAIR RAILINGS

A. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.

1. Rails and Posts: **1-5/8-inch- (41-mm-)** diameter top and bottom rails and 1-1/2-inch- (38-mm-) square posts.
2. Picket Infill: 1/2-inch- (13-mm-) square pickets spaced less than 4 inches (100 mm) clear.
3. Expanded-Metal Infill: Expanded-metal panels with long dimension of diamonds perpendicular to top rail.
4. Perforated-Metal Infill: Perforated-metal panels with pattern as indicated on Drawings.
5. Mesh Infill: Woven wire mesh in steel channel frames with horizontal and vertical.
6. Intermediate Rails Infill: 1-5/8-inch- (41-mm-) diameter intermediate rails spaced less than 21 inches (533 mm) clear.

B. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: completely sanded joint, some undercutting and pinholes okay.

C. Form changes in direction of railings by bending.

D. Form curves by bending members in jigs to produce uniform curvature without buckling.

E. Close exposed ends of railing members with prefabricated end fittings.

F. Provide wall returns at ends of wall-mounted handrails.

G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.

1. Connect posts to stair framing by direct welding.

H. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, to transfer wall bracket loads through wall finishes. Size fillers to suit wall finish thicknesses.

2.6 FINISHES

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

B. Finish metal stairs after assembly.

C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

D. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

E. Apply shop primer to uncoated surfaces of metal stair components. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

B. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

C. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication.

D. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

E. Place and finish concrete fill for treads and platforms to comply with Division 03 Section "Cast-in-Place Concrete."

1. Install abrasive nosings with anchors fully embedded in concrete.

F. Install precast concrete treads with adhesive supplied by manufacturer.

G. Attach handrails to wall with wall brackets. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.

3.2 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

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

END OF SECTION

SECTION 055113 - METAL PAN STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preassembled steel stairs with [concrete-filled][precast concrete][precast terrazzo][epoxy-resin-filled][and][abrasive-coating-finished, formed-metal] treads.
2. [Steel tube] railings and guards attached to metal stairs.
3. [Steel tube] handrails attached to walls adjacent to metal stairs.
4. Railing gates at the level of exit discharge.

1.2 COORDINATION

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

B. Coordinate installation of anchorages for metal stairs [, railings, and guards].

1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, [blocking for attachment of wall-mounted handrails,] and items with integral anchors, that are to be embedded in concrete or masonry.
2. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width and are within fire-resistance-rated stair enclosure.

D. Schedule installation of railings and guards so wall attachments are made only to completed walls.

1. Do not support railings and guards temporarily by any means that do not satisfy structural performance requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For metal pan stairs and the following:

1. Perforated metal.
2. Woven-wire mesh.
3. Welded-wire mesh.
4. Prefilled metal-pan-stair treads.
5. Abrasive nosings.

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6. Shop primer products.
7. Nonslip-aggregate concrete finish.
8. Abrasive-coating finish to formed-metal stairs.
9. Precast concrete treads.
10. Precast terrazzo treads.
11. Epoxy-resin-filled stair treads.
12. Handrail wall brackets.
13. Grout.

B. Sustainable Design Submittals:

1. Environmental product declaration.
2. Third-Party Certifications: For each product.
3. Third-Party Certified Life Cycle Assessment: For each product.

C. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Include plan at each level.
4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.
5. Indicate profile and dimensions of precast terrazzo treads.
6. Indicate profile and dimensions of epoxy-resin-filled treads.

D. Samples for Verification: For each type and finish of [nosing][precast terrazzo tread][epoxy-resin-filled tread].

E. Delegated Design Submittal: For stairs, [railings and guards,][precast terrazzo treads,][epoxy-resin-filled treads], including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed in the [jurisdiction][State] in which Project is located.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

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

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1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification.

1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
2. Protect steel members and packaged materials from corrosion and deterioration.
3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.

a. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs, [railings and guards,][precast terrazzo treads,][epoxy-resin-filled treads], including attachment to building construction.

B. Structural Performance of Stairs: Metal stairs withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft..
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to [L/360]<Insert deflection ratio> or 1/4 inch, whichever is less.

C. Structural Performance of Railings and Guards: Railings and guards, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
b. Infill load and other loads need not be assumed to act concurrently.

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3. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

    a. Temperature Change: [120 deg F, ambient; 180 deg F, material surfaces]<Insert temperature change>.

D. Seismic Performance of Stairs: Metal stairs withstand the effects of earthquake motions determined according to [ASCE/SEI 7]<Insert requirement>.

1. Component Importance Factor: <Insert requirement>.

2.2 METALS

A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Steel Tubing for Railings and Guards: [ASTM A500/A500M (cold formed)][or][ASTM A513/A513M].

1. Provide galvanized finish for exterior installations and where indicated.

D. Steel Pipe for Railings and Guards: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25]<Insert value> percent.
2. Provide galvanized finish for exterior installations and where indicated.

E. Uncoated, Cold-Rolled Steel Sheet: ASTM A1008/A1008M, [either commercial steel, Type B, or] structural steel, Grade 25, unless another grade is required by design loads; exposed.

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25]<Insert value> percent.

F. Uncoated, Hot-Rolled Steel Sheet: ASTM A1011/A1011M, [either commercial steel, Type B, or] structural steel, Grade 30, unless another grade is required by design loads.

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25]<Insert value> percent.

G. Galvanized Steel Sheet: ASTM A653/A653M, G90 coating, [either commercial steel, Type B, or] structural steel, Grade 33, unless another grade is required by design loads.

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1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25]<Insert value> percent.

H. Expanded-Metal, Carbon Steel: ASTM F1267, [Type I (expanded)][Type II (expanded and flattened)], Class 1 (uncoated).

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25]<Insert value> percent.
2. Style Designation: [3/4 number 13][1-1/2 number 10]<Insert designation>.

I. Perforated Metal, Uncoated: Cold-rolled steel sheet, ASTM A1008/A1008M, or hot-rolled steel sheet, ASTM A1011/A1011M, commercial steel Type B, [0.060 inch]<Insert dimension> thick, [with 1/4-inch holes 3/8 inch o.c. in staggered rows][with 1/8-by-1-inch round end slotted holes in staggered rows]<Insert description>.

J. Perforated Metal, Galvanized Steel Sheet: ASTM A653/A653M, G90 coating, commercial steel Type B, [0.064 inch]<Insert dimension> thick, [with 1/4-inch holes 3/8 inch o.c. in staggered rows]<Insert description>.

K. Perforated Metal, Aluminum Sheet: ASTM B209, [0.125 inch][0.063 inch]<Insert dimension> thick, [with 1/4-inch holes 3/8 inch o.c. in staggered rows]<Insert description>.

1. Recycled Content of Aluminum Components: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25][50]<Insert value> percent.

L. Woven-Wire Mesh, Steel: Intermediate-crimp, [diamond][square] pattern, 2-inch woven-wire mesh, made from 0.135-inch nominal-diameter steel wire complying with ASTM A510/A510M.

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25]<Insert value> percent.

M. Woven-Wire Mesh, Aluminum: Intermediate-crimp, [diamond][square] pattern, 2-inch woven-wire mesh, made from 0.162-inch- diameter, aluminum wire complying with ASTM B211, Alloy 6061-T94.

1. Recycled Content of Aluminum Components: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25][50]<Insert value> percent.

N. Welded-Wire Mesh: [Diamond][Square] pattern, 2-inch welded-wire mesh, made from 0.236-inch nominal-diameter steel wire complying with ASTM A510/A510M.

O. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.

1. Recycled Content of Aluminum Components: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25][50]<Insert value> percent.

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P. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

1. Recycled Content of Aluminum Components: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25][50]<Insert value> percent.

Q. Bronze Extrusions: ASTM B455, Alloy UNS No. C38500 (extruded architectural bronze).

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert value> percent.

R. Bronze Castings: ASTM B584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert value> percent.

S. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert value> percent.

T. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert value> percent.

2.3 ABRASIVE NOSINGS

A. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

B. Apply bituminous paint to concealed surfaces of cast-metal units set into concrete.

C. Apply clear lacquer to concealed surfaces of extruded units set into concrete.

2.4 FASTENERS

A. General: Provide [zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5][Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5] where built into exterior walls.

1. Select fasteners for type, grade, and class required.

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B. Fasteners for Anchoring Railings and Guards to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings and guards to other types of construction indicated [and capable of withstanding design loads].

C. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.

1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for [exterior stairs][stairs indicated to be galvanized][stairs indicated to be shop primed with zinc-rich primer].

E. Post-Installed Anchors: [Torque-controlled expansion anchors][or][chemical anchors] capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy [Group 1][Group 2] stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.5 MISCELLANEOUS MATERIALS

A. Welding Electrodes: Comply with AWS requirements.

B. Shop Primers: Provide primers that comply with [Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."][Section 099600 "High-Performance Coatings."][Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."]

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

D. Zinc-Rich Primer: Comply with SSPC-Paint 20, [Type I-A][Type I-B][Type I-C][Type II], Level [1][2][3], and compatible with topcoat.

E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish system indicated.

F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with [SSPC-Paint 20][ASTM A780/A780M] and compatible with paints specified to be used over it.

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G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

H. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for [interior][exterior] use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.

I. Prefilled Concrete Treads:

1. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with minimum 28-day compressive strength of 3000 psi and maximum aggregate size of 1/2 inch unless otherwise indicated.
2. Nonslip-Aggregate Concrete Finish: Factory-packaged abrasive aggregate made from fused, aluminum-oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.
3. Plain Steel Welded-Wire Reinforcement: ASTM A1064/A10645M, [steel,][galvanized steel,] 6 by 6 inches, W1.4 by W1.4, unless otherwise indicated on Drawings.

    a. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25]<Insert value> percent.

4. Reinforcement Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening welded-wire reinforcement in place.

    a. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.

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

2.6 PRECAST CONCRETE TREADS

A. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, ready-mixed concrete with a minimum 28-day compressive strength of 5000 psi and a total air content of not less than 4 percent or more than 6 percent.

B. Reinforcement: Galvanized, welded-wire reinforcement, 2 by 2 inches by 0.062-inch-diameter steel wire; comply with ASTM A1064/A1064M, except for minimum wire size.

2.7 EPOXY-RESIN-FILLED TREADS

A. Epoxy-Resin-Filled Treads: 3/8-inch- thick, epoxy resin with 8000-psi compressive strength; set on steel subtread.

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1. Color: As selected by Architect from manufacturer's standard color selections.

2.8 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, [railings and guards,] clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Assemble stairs [, railings, and guards] in shop to greatest extent possible.

1. Disassemble units only as necessary for shipping and handling limitations.
2. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for [Finish #1 - No evidence of welded joint][Finish #2 - Completely sanded joint with some undercutting and pinholes okay][Finish # 3 - Partially dressed weld with spatter removed][Finish # 4 - Good quality, uniform undressed weld with minimal splatter].

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.

1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
2. Locate joints where least conspicuous.
3. Fabricate joints that will be exposed to weather in a manner to exclude water.
4. Provide weep holes where water may accumulate internally.

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2.9 FABRICATION OF STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for [Architectural][Commercial][Service] Class, unless more stringent requirements are indicated.

B. Stair Framing:

1. Stringers: Fabricate of [steel plates][or][steel channels][or][steel rectangular tubes][as indicated on Drawings].

    a. Stringer Size: [As required to comply with "Performance Requirements" Article][As indicated on Drawings].
    b. Provide closures for exposed ends of channel and rectangular tube stringers.
    c. Finish: [Shop primed][Painted][Galvanized].

2. Platforms: Construct of [steel plate][or][steel channel][or][steel rectangular tube] headers and miscellaneous framing members as [required to comply with "Performance Requirements" Article][indicated on Drawings].

    a. Provide closures for exposed ends of channel and rectangular tube framing.
    b. Finish: [Shop primed][Painted][Galvanized].

3. Weld [or bolt] stringers to headers; weld [or bolt] framing members to stringers and headers. [If using bolts, fabricate and join so bolts are not exposed on finished surfaces.]
4. Where stairs are enclosed by gypsum board [shaft-wall] assemblies, provide hanger rods or struts to support landings from floor construction above or below.

    a. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.

5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch.

1. Fabricate treads and landing subplatforms of exterior stairs so finished walking surfaces slope to drain.
2. Steel Sheet, Uncoated: [Cold][Hot] -rolled steel sheet [unless otherwise indicated].
3. Galvanized Steel Sheet: Galvanized steel sheet [, where indicated].
4. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
5. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.

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6. Shape metal pans to include nosing integral with riser.
7. Attach abrasive nosings to risers.
8. At Contractor's option, provide stair assemblies with metal pan subtreads filled with reinforced concrete during fabrication.
9. Provide epoxy-resin-filled treads, reinforced with glass fibers, with non-slip-concrete aggregate finish to tread surface.
10. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

    a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

D. Abrasive-Coating-Finished, Formed-Metal Stairs: Form risers, treads, and platforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.097 inch.

1. Steel Sheet: Uncoated, hot-rolled steel sheet unless otherwise indicated.
2. Directly weld risers and treads to stringers; locate welds on underside of stairs.
3. Provide platforms of configuration indicated or, if not indicated, the same as treads. Weld platforms to platform framing.
4. Finish tread and platform surfaces with manufacturer's standard epoxy-bonded abrasive finish.

2.10 FABRICATION OF STAIR RAILINGS AND GUARDS

A. Comply with applicable requirements in [Section 055213 "Pipe and Tube Railings."][Section 057300 "Decorative Metal Railings."]

B. Fabricate railings and guards to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.

1. Rails and Posts: [1-5/8-inch- diameter][1-1/2-inch- square] top and bottom rails and 1-1/2-inch- square posts.
2. Picket Infill: [1/2-inch-][3/4-inch-][round][square] pickets spaced to prohibit the passage of a 4-inch diameter sphere.
3. Expanded-Metal Infill: Expanded-metal panels edged with U-shaped channels made from steel sheet and not less than 0.043 inch thick. Orient expanded metal with long dimension of diamonds [parallel to top rail][perpendicular to top rail][vertical].
4. Perforated-Metal Infill: Perforated-metal panels edged with U-shaped channels made from metal sheet, of same metal as perforated metal, and not less than 0.043 inch thick. Orient perforated metal with pattern [parallel to top rail][perpendicular to top rail][horizontal][vertical][as indicated on Drawings].
5. Mesh Infill: [Woven][Welded] -wire mesh crimped into 1-by-1/2-by-1/8-inch steel channel frames. Orient wire mesh with [diamonds vertical][wires perpendicular and parallel to top rail][wires horizontal and vertical].
6. Intermediate Rails Infill: [1-5/8-inch- diameter][1-1/2-inch- square] intermediate

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rails spaced less than [12 inches][21 inches] clear.

7. Gates: Form gates from steel tube of same size and shape as top rails, with infill to match guards. Provide with [cam-type, self-closing][spring] hinges for fastening to wall and overlapping stop with rubber bumper to prevent gate from opening in direction opposite egress.

C. Welded Connections: Fabricate railings and guards with welded connections.

1. Fabricate connections that are exposed to weather in a manner that excludes water.

    a. Provide weep holes where water may accumulate internally.

2. Cope components at connections to provide close fit, or use fittings designed for this purpose.
3. Weld all around at connections, including at fittings.
4. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
5. Obtain fusion without undercut or overlap.
6. Remove flux immediately.
7. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for [Finish #1 - No evidence of a welded joint][Finish #2 - Completely sanded joint, some undercutting and pinholes are okay][Finish #3 - Partially dressed weld with spatter removed][Finish #4 - Good quality, uniform undressed weld with minimal splatter] as shown in NAAMM AMP 521.

D. Form changes in direction of railings and guards as follows:

1. As detailed.
2. By bending [or by inserting prefabricated elbow fittings].
3. By flush bends [or by inserting prefabricated flush-elbow fittings].
4. By radius bends of radius indicated [or by inserting prefabricated elbow fittings of radius indicated].
5. By inserting prefabricated [elbow fittings][flush-elbow fittings][elbow fittings of radius indicated].

E. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

F. Close exposed ends of railing and guard members with prefabricated end fittings.

G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.

1. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

H. Connect posts to stair framing by direct welding unless otherwise indicated.

I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges,

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miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.

1. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
2. For galvanized railings and guards, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
3. For nongalvanized railings and guards, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
4. Provide type of bracket [with flange tapped for concealed anchorage to threaded hanger bolt][with predrilled hole for exposed bolt anchorage] and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

J. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports.

1. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.11 FINISHES

A. Finish metal stairs after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

C. Preparation for Shop Priming: Prepare uncoated, ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.

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1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.

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

3.2 INSTALLATION OF METAL PAN STAIRS

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.

1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

1. Grouted Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates.

a. Clean bottom surface of plates.
b. Set plates for structural members on wedges, shims, or setting nuts.
c. Tighten anchor bolts after supported members have been positioned and plumbed.
d. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
e. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.

1) Neatly finish exposed surfaces; protect grout and allow to cure.
2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

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

E. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
3. Comply with requirements for welding in "Fabrication, General" Article.

F. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."

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1. Install abrasive nosings with anchors fully embedded in concrete.
2. Center nosings on tread width.

G. Install precast concrete treads with adhesive supplied by manufacturer.

H. Install precast terrazzo treads according to manufacturer's written instructions.

3.3 INSTALLATION OF RAILINGS AND GUARDS

A. Adjust railing and guard systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.

1. Space posts at spacing indicated or, if not indicated, as required by design loads.
2. Plumb posts in each direction, within a tolerance of 1/16 inch in 3 feet.
3. Align rails and guards so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet.
4. Secure posts, rail ends, and guard ends to building construction as follows:

    a. Anchor posts to steel by [welding][or][bolting] to steel supporting members.
    b. Anchor handrail and guard ends to concrete and masonry with steel round flanges welded to rail and guard ends and anchored with post-installed anchors and bolts.

B. Install railing gates level, plumb, and secure for full opening without interference.

1. Attach hardware using tamper-resistant or concealed means.
2. Adjust hardware for smooth operation.

C. Attach handrails to wall with wall brackets.

1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
2. Secure wall brackets to building construction as [required to comply with performance requirements.][follows:]

    a. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
    b. For hollow masonry anchorage, use toggle bolts.
    c. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
    d. For steel-framed partitions, use hanger or lag bolts set into [fire-retardant-treated] wood backing between studs. Coordinate with stud installation to locate backing members.
    e. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
    f. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

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3.4 REPAIR

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in [Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."][Section 099600 "High-Performance Coatings."][Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."]

B. Repair of Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055113

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SECTION 055119 - METAL GRATING STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal grating stairs.
2. Steel railings and guards.

1.2 COORDINATION

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

B. Coordinate installation of anchorages for metal grating stairs [, railings, and guards].

1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, [blocking for attachment of wall-mounted handrails,] and items with integral anchors, that are to be embedded in concrete or masonry.
2. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width and are within fire-resistance-rated stair enclosure.

D. Schedule installation of railings and guards so wall attachments are made only to completed walls.

1. Do not support railings and guards temporarily by any means that do not satisfy structural performance requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For metal grating stairs and the following:

1. Gratings.
2. Woven-wire mesh.
3. Welded-wire mesh.
4. Shop primer products.
5. Grout.

B. Shop Drawings:

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1. Include plans, elevations, sections, details, and attachment to other work.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Include plan at each level.
4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.

C. Delegated Design Submittals: For stairs [, railings, and guards], including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Sustainable Design Submittals:

1. Product Data for Embodied Carbon Emissions: Indicating embodied carbon emissions, defined as GWP/unit times material amount used in Project.
2. Product Data for Cradle-to-Cradle Certification:

    a. Confirming Cradle-to-Cradle certification under Version 3.1, 4, or 4.1 at Bronze level. Submittal must contain inventory assessment completed to at least 0.1 percent (1000 ppm) and certification expiration.
    b. Confirming Cradle-to-Cradle certification under Version 3.1, 4, or 4.1 at Silver level or Material Health Silver Certificate. Submittal must contain inventory assessment completed to at least 0.01 percent (100 ppm) and certification expiration.
    c. Confirming Cradle-to-Cradle certification under Version 3.1, 4, or 4.1 at Gold level or Material Health Gold Certificate. Submittal must contain inventory assessment completed to at least 0.01 percent (100 ppm) and certification expiration.

3. Product Data for Health Product Declaration Compliance:

    a. Prechecked for LEED HPD with full ingredient inventory to at least 0.1 percent (1000 ppm) and proof of publication in HPD Repository Standard.
    b. HPD prechecked for LEED v4.1, Option 2, confirming that either no GreenScreen LT-1 hazards or no GHS Category 1 hazards are present in installed product. Submittal must contain inventory assessment completed to at least 0.01 percent (100 ppm) and HPD expiration.

4. Product Data for Declare Certification:

    a. Confirming Declare certification under Version 2. Submittal must contain inventory assessment completed to at least 0.1 percent (1000 ppm) and certification expiration date.
    b. Confirming Declare certification Third-Party Verified and Red List Free or Red List Approved. Submittal must contain inventory assessment completed to at least 0.01 percent (100 ppm) and certification expiration date.

5. Product Data for Global Green Tag: Product Health Data (PhD) containing inventory assessment completed to at least 0.1 percent (1000 ppm) and certification expiration date.

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1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed in the [jurisdiction][State] in which Project is located.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification.

1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
2. Protect steel members and packaged materials from corrosion and deterioration.
3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.

a. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal grating stairs [, railings, and guards], including attachment to building construction.

B. Structural Performance of Metal Grating Stairs: Withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft..
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to [L/360]<Insert

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deflection ratio>.

C. Structural Performance of Stair Railings and Guards: Railings and guards, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
b. Infill load and other loads need not be assumed to act concurrently.

3. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

a. Temperature Change: [120 deg F, ambient; 180 deg F, material surfaces]<Insert temperature change>.

D. Seismic Performance of Stairs: Metal stairs withstand the effects of earthquake motions determined according to [ASCE/SEI 7]<Insert requirement>.

1. Component Importance Factor: <Insert requirement>.

2.2 METALS

A. Metals, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

D. Steel Bars for Grating Treads: ASTM A36/A36M or steel strip, ASTM A1011/A1011M or ASTM A1018/A1018M.

E. Steel Wire Rod for Grating Crossbars: ASTM A510/A510M.

F. Aluminum Bars for Grating Treads: ASTM B221 extruded aluminum, alloys as follows:

1. 6061-T6 or 6063-T6, for bearing bars of gratings and shapes.

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2. 6061-T1, for grating crossbars.

G. Steel Tubing for Railings and Guards: [ASTM A500/A500M (cold formed)][or][ASTM A513/A513M].

1. Provide galvanized finish for exterior installations and where indicated.

H. Steel Pipe for Railings and Guards: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

I. Provide galvanized finish for exterior installations and where indicated.

J. Woven-Wire Mesh, Steel: Intermediate-crimp, [diamond][square] pattern, 2-inch woven-wire mesh, made from 0.135-inch nominal-diameter steel wire complying with ASTM A510/A510M.

K. Woven-Wire Mesh, Aluminum: Intermediate-crimp, [diamond][square] pattern, 2-inch woven-wire mesh, made from 0.162-inch- diameter, aluminum wire complying with ASTM B211, Alloy 6061-T94.

L. Welded-Wire Mesh: [Diamond][Square] pattern, 2-inch welded-wire mesh, made from 0.236-inch nominal-diameter steel wire complying with ASTM A510/A510M.

M. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

N. Cast-Abrasive Nosings: Cast iron, with an integral abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both.

2.3 FASTENERS

A. General: Provide [zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5][Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5] where built into exterior walls.

1. Select fasteners for type, grade, and class required.

B. Fasteners for Anchoring Railings and Guards to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings and guards to other types of construction indicated [and capable of withstanding design loads].

C. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.

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1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for [exterior stairs][stairs indicated to be galvanized][stairs indicated to be shop primed with zinc-rich primer].

E. Post-Installed Anchors: [Torque-controlled expansion anchors][or][chemical anchors] capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy [Group 1][Group 2] stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.4 MISCELLANEOUS MATERIALS

A. Welding Electrodes: Comply with AWS requirements.

B. Shop Primers: Provide primers that comply with [Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."][Section 099600 "High-Performance Coatings."][Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."]

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

D. Zinc-Rich Primer: Comply with SSPC-Paint 20, [Type I-A][Type I-B][Type I-C][Type II], Level [1][2][3], and compatible with topcoat.

E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with [SSPC-Paint 20][ASTM A780/A780M] and compatible with paints specified to be used over it.

G. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for [interior][exterior] use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, railings, guards, clips, brackets, bearing plates, and other components necessary to support and anchor

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stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Assemble stairs [, railings, and guards] in shop to greatest extent possible.

1. Disassemble units only as necessary for shipping and handling limitations.
2. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for [Finish # 3 - Partially dressed weld with spatter removed][Finish #4 - Good quality, uniform undressed weld with minimal splatter].

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.

1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
2. Locate joints where least conspicuous.
3. Fabricate joints that are exposed to weather in a manner to exclude water.
4. Provide weep holes where water may accumulate internally.

2.6 FABRICATION OF METAL GRATING STAIRS

A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Industrial Class, unless more stringent requirements are indicated.

B. Stair Framing:

1. Fabricate stringers of steel [plates][or][channels].

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a. Stringer Size: [As required to comply with "Performance Requirements" Article][As indicated on Drawings].
b. Provide closures for exposed ends of channel stringers.
c. Finish: [Shop primed][Painted][Galvanized].

2. Construct platforms and tread supports of steel [plate][or][channel] headers and miscellaneous framing members as [required to comply with "Performance Requirements" Article][indicated on Drawings].

a. Provide closures for exposed ends of channel framing.
b. Finish: [Shop primed][Painted][Galvanized].

3. Weld [or bolt] stringers to headers; weld [or bolt] framing members to stringers and headers.
4. Where stairs are enclosed by gypsum board [shaft-wall] assemblies, provide hanger rods or struts to support landings from floor construction above or below.

a. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.

5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."

1. Fabricate treads and platforms from [welded steel][or][pressure-locked steel][pressure-locked aluminum] grating with [1-1/4-by-3/16-inch bearing bars at 15/16 inch o.c.][1-by-3/16-inch bearing bars at 11/16 inch o.c.][1-by-1/8-inch bearing bars at 7/16 inch o.c.] and crossbars at 4 inches o.c.
2. Fabricate treads and platforms from [welded steel][or][pressure-locked steel][pressure-locked aluminum] grating with openings in gratings no more than [5/16 inch][1/2 inch][3/4 inch][1 inch] in least dimension.

a. Surface: [Plain][Serrated].
b. Finish: [Shop primed][Painted][Galvanized][Mill].

3. Fabricate grating treads with [rolled-steel floor plate][cast-abrasive] nosing and with steel angle or steel plate carrier at each end for stringer connections.

a. Secure treads to stringers with bolts.

4. Fabricate grating platforms with nosing matching that on grating treads.

a. Secure grating to platform framing [by welding][with bolts].

D. Risers: [Open][Solid].

E. Toe Plates: Provide toe plates around openings and at edge of open-sided floors and platforms, and at open ends and open back edges of treads.

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1. Material and Finish: Steel plate to match finish of other steel items.
2. Fabricate to dimensions and details indicated.

2.7 FABRICATION OF STAIR RAILINGS AND GUARDS

A. Comply with applicable requirements in Section 055213 "Pipe and Tube Railings."

B. Fabricate railings and guards to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.

1. Rails and Posts: [1-5/8-inch- diameter][1-1/2-inch- square] top and bottom rails and 1-1/2-inch- square posts.
2. Picket Infill: [1/2-inch-][3/4-inch][round][square] pickets spaced to prohibit the passage of a 4-inch diameter sphere.
3. Mesh Infill: [Woven][Welded] -wire mesh [crimped][welded] into 1-by-1/2-by-1/8-inch steel channel frames. Orient wire mesh with [diamonds vertical][wires perpendicular and parallel to top rail][wires horizontal and vertical].
4. Intermediate Rails Infill: [1-5/8-inch- diameter][1-1/2-inch- square] intermediate rails spaced less than [12 inches][21 inches] clear.

C. Welded Connections: Fabricate railings and guards with welded connections.

1. Fabricate connections that are exposed to weather in a manner that excludes water.

    a. Provide weep holes where water may accumulate internally.

2. Cope components at connections to provide close fit, or use fittings designed for this purpose.
3. Weld all around at connections, including at fittings.
4. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
5. Obtain fusion without undercut or overlap.
6. Remove flux immediately.
7. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for [Finish #3 - Partially dressed weld with spatter removed][Finish #4 - Good quality, uniform undressed weld with minimal splatter] as shown in NAAMM AMP 521.

D. Form changes in direction of railings and guards as follows:

1. As detailed on Drawings.
2. By bending [or by inserting prefabricated elbow fittings].
3. By flush bends [or by inserting prefabricated flush-elbow fittings].
4. By radius bends of radius indicated [or by inserting prefabricated elbow fittings of radius indicated].
5. By inserting prefabricated [elbow fittings][flush-elbow fittings][elbow fittings of radius indicated].

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E. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required.

1. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

F. Close exposed ends of railing and guard members with prefabricated end fittings.

G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.

1. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

H. Connect posts to stair framing by direct welding unless otherwise indicated.

I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.

1. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
2. For galvanized railings and guards, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
3. For nongalvanized railings and guards, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
4. Provide type of bracket [with flange tapped for concealed anchorage to threaded hanger bolt][with predrilled hole for exposed bolt anchorage] and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

J. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports.

1. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.8 FINISHES

A. Finish metal stairs after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with

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[SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."][SSPC-SP 3, "Power Tool Cleaning."][minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed products:]

1. Exterior Stairs: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Interior Stairs:

    a. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
    b. SSPC-SP 3, "Power Tool Cleaning."

D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.

1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.

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

3.2 INSTALLATION OF METAL GRATING STAIRS

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.

1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

1. Grouted Baseplates: Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces.

    a. Clean bottom surface of baseplates.

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b. Set steel-stair baseplates on wedges, shims, or leveling nuts.
c. After stairs have been positioned and aligned, tighten anchor bolts.
d. Do not remove wedges or shims, but if protruding, cut off flush with edge of bearing plate before packing with grout.
e. Promptly pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

1) Neatly finish exposed surfaces; protect grout and allow to cure.
2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

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

E. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
3. Comply with requirements for welding in "Fabrication, General" Article.

3.3 INSTALLATION OF STAIR RAILINGS AND GUARDS

A. Adjust railing and guard systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.

1. Space posts at spacing indicated or, if not indicated, as required by design loads.
2. Plumb posts in each direction, within a tolerance of 1/16 inch in 3 feet.
3. Align rails and guards so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet.
4. Secure posts, rail ends, and guard ends to building construction as follows:

a. Anchor posts to steel by [welding][or][bolting] to steel supporting members.
b. Anchor handrail and guard ends to concrete and masonry with steel round flanges welded to rail and guard ends and anchored with post-installed anchors and bolts.

B. Attach handrails to wall with wall brackets.

1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
2. Secure wall brackets to building construction as [required to comply with performance requirements.][follows:]

a. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
b. For hollow masonry anchorage, use toggle bolts.
c. For wood stud partitions, use hanger or lag bolts set into studs or wood

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backing between studs. Coordinate with carpentry work to locate backing members.

d. For steel-framed partitions, use hanger or lag bolts set into [fire-retardant-treated] wood backing between studs. Coordinate with stud installation to locate backing members.
e. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
f. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.4 REPAIR

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

    a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in [Section 099113 "Exterior Painting."][Section 099123 "Interior Painting."][and][Section 099600 "High-Performance Coatings."]

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055119

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SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Requirements:

1. Section 055113 "Metal Pan Stairs" for steel tube railings associated with metal pan stairs.
2. Section 057300 "Decorative Metal Railings" for ornamental railings fabricated from pipes and tubes and guard-infill metals.
3. Section 096900 "Access Flooring" for railings included with access flooring.

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

1.3 ACTION SUBMITTALS

A. Product Data:

1. Manufacturer's product lines of mechanically connected railings.
2. Expanded metal infill panels.
3. Perforated metal infill panels.
4. Woven-wire mesh infill panels.
5. Fasteners.
6. Post-installed anchors.
7. Handrail brackets.
8. Shop primer.
9. Intermediate coats and topcoats.
10. Bituminous paint.
11. Nonshrink, nonmetallic grout.
12. Anchoring cement.
13. Metal finishes.
14. Paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

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C. Samples for Initial Selection: For products involving selection of color, texture, or design [, including mechanical finishes].

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

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters, including finish.
2. Fittings and brackets.
3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.

a. Show method of [connecting][and][finishing] members at intersections.

E. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For [delegated design professional engineer][testing agency].

B. Welding certificates.

C. Mill Certificates: Signed by manufacturers of stainless steel products, certifying that products furnished comply with requirements.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

E. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.

F. Research Reports: For post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

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1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: [120 deg F, ambient; 180 deg F, material surfaces]<Insert temperature change>.

2.2 METALS, GENERAL

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

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with [flange tapped for concealed anchorage to threaded hanger bolt][predrilled hole for exposed bolt anchorage] and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

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2.3 FASTENERS

A. Fastener Materials:

1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with ASTM F1941/F1941M, Class Fe/Zn 5 for zinc coating.
2. Hot-Dip Galvanized Railing Components: Type 304 stainless steel or hot-dip zinc-coated steel fasteners complying with ASTM A153/A153M or ASTM F2329/F2329M for zinc coating.
3. Aluminum Railing Components: [Type 304][Type 316] stainless steel fasteners.
4. Stainless Steel Railing Components: [Type 304][Type 316] stainless steel fasteners.
5. Finish exposed fasteners to match appearance, including color and texture, of railings.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction [and capable of withstanding design loads].

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
3. Provide [Phillips][tamper-resistant][square or hex socket] flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 [or ICC-ES AC308].

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy [Group 1][Group 2] stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.4 MISCELLANEOUS MATERIALS

A. Handrail Brackets: [Cast iron][Cast aluminum,][Cast stainless steel,][Cast nickel-silver,] center of handrail [2-1/2 inches][3-1/8 inches]<Insert dimension> from [face of railing][wall].

B. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.

1. For [aluminum][and][stainless steel] railings, provide type and alloy as recommended by producer of metal to be welded and as required for color

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match, strength, and compatibility in fabricated items.

C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

D. Galvanizing Repair Paint: High-zinc-dust-content paint, complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Shop Primers: Provide primers that comply with [Section 099113 "Exterior Painting."][Section 099123 "Interior Painting."][Section 099600 "High-Performance Coatings."]

F. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

G. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

H. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

I. Intermediate Coats and Topcoats: Provide products that comply with [Section 099113 "Exterior Painting."][Section 099123 "Interior Painting."][Section 099600 "High-Performance Coatings."]

J. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.

K. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.

L. Bituminous Paint: Cold-applied asphalt emulsion, complying with ASTM D1187/D1187M.

M. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

N. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: [At exterior locations][and][where indicated on Drawings], provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.5 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design,

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dimensions, member sizes and spacing, details, finish, and anchorage [, but not less than that required to support structural loads].

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.

1. Clearly mark units for reassembly and coordinated installation.
2. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water.

1. Provide weep holes where water may accumulate.
2. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with [welded][or][nonwelded] connections unless otherwise indicated.

H. Gates: Form gates from steel tube of same size and shape as top rails, with infill to match guards. Provide with [cam-type, self-closing][spring] hinges for fastening to wall and overlapping stop with rubber bumper to prevent gate from opening in direction opposite egress.

I. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

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 flux immediately.
4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 welds; ornamental quality with no evidence of a welded joint.

J. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

K. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

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1. Fabricate splice joints for field connection, using an epoxy structural adhesive, if this is manufacturer's standard splicing method.

L. Form changes in direction as follows:

1. As detailed.
2. [By bending][or][by inserting prefabricated elbow fittings].
3. [By flush bends][or][by inserting prefabricated flush-elbow fittings].
4. [By radius bends of radius indicated][or][by inserting prefabricated elbow fittings of radius indicated].
5. By bending to smallest radius that will not result in distortion of railing member.

M. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

N. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.

O. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

P. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

Q. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.

1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
2. Coordinate anchorage devices with supporting structure.

R. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

S. For removable railing posts, fabricate slip-fit sockets from stainless steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height.

1. Provide socket covers designed and fabricated to resist being dislodged.
2. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

T. Expanded-Metal Infill Panels: Fabricate infill panels from expanded-metal sheet of same metal as railings.

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1. Edge panels with U-shaped channels made from metal sheet, of same metal as expanded metal and not less than 0.043 inch thick.
2. Orient expanded metal with long dimension of diamonds [parallel to top rail][perpendicular to top rail][horizontal][vertical].

U. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from [steel][galvanized steel][aluminum][stainless steel][same metal as railings in which they are installed].

1. Edge panels with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than 0.043 inch thick.
2. Orient perforated metal with pattern [parallel to top rail][perpendicular to top rail][horizontal][vertical][as indicated on Drawings].

V. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1-by-1/2-by-1/8-inch metal channel frames.

1. Fabricate wire mesh and frames from same metal as railings in which they are installed.
2. Orient wire mesh with [diamonds vertical][diamonds perpendicular to top rail][wires perpendicular and parallel to top rail][wires horizontal and vertical][as indicated on Drawings].

W. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.6 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize [exterior][indicated] steel railings, including hardware, after fabrication.
2. Comply with ASTM A123/A123M for hot-dip galvanized railings.
3. Comply with ASTM A153/A153M for hot-dip galvanized hardware.
4. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner [and as follows].

1. Comply with SSPC-SP 16.

D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, hot-dip galvanize anchors to be embedded

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in exterior concrete or masonry.

E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with [SSPC-SP 6/NACE No. 3.][SSPC-SP 3.][requirements indicated below:]

1. Exterior Railings: SSPC-SP 6/NACE No. 3.
2. Railings Indicated To Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3.
3. Railings Indicated To Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3.
4. Other Railings: SSPC-SP 3.

F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with [universal shop primer][primers specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting"] unless [zinc-rich primer is][primers specified in Section 099600 "High-Performance Coatings" are] indicated.
2. Do not apply primer to galvanized surfaces.

G. Shop-Painted Finish: Comply with [Section 099113 "Exterior Painting."][Section 099600 "High-Performance Coatings."]

1. Color: [As indicated by manufacturer's designations][Match Architect's sample][As selected by Architect from manufacturer's full range].

H. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1 for shop painting. Apply at spreading rates recommended by coating manufacturer.

1. Color: [As indicated by manufacturer's designations][Match Architect's sample][As selected by Architect from manufacturer's full range].

2.7 ALUMINUM FINISHES

A. 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 unacceptable. 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.

B. Mill Finish: AA-M12, nonspecular as fabricated.

C. Clear Anodic Finish: AAMA 611, [AA-M12C22A41][AA-M12C22A31].

D. Color Anodic Finish: AAMA 611, [AA-M12C22A42/A44][AA-M12C22A32/A34].

1. Color: [Light bronze][Medium bronze][Dark bronze][Black][Match Architect's

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sample][As selected by Architect from full range of industry colors and color densities].

E. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: [As indicated by manufacturer's designations][Match Architect's sample][As selected by Architect from manufacturer's full range]<Insert color and gloss>.

F. High-Performance Organic Finish, Two-Coat Polyvinylidene Fluoride (PVDF): Fluoropolymer finish complying with [AAMA 2604][AAMA 2605] and containing not less than [50][70] percent polyvinylidene fluoride (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 [for seacoast and severe environments].

1. Color and Gloss: [As indicated by manufacturer's designations][Match Architect's sample][As selected by Architect from manufacturer's full range]<Insert color and gloss>.

G. Superior Performance Organic Finish, Three-Coat Polyvinylidene Fluoride (PVDF): Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions [for seacoast and severe environments].

1. Color and Gloss: [As indicated by manufacturer's designations][Match Architect's sample][As selected by Architect from manufacturer's full range]<Insert color and gloss>.

H. Superior Performance Organic Finish, Four-Coat Polyvinylidene Fluoride (PVDF): Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions [for seacoast and severe environments].

1. Color and Gloss: [As indicated by manufacturer's designations][Match Architect's sample][As selected by Architect from manufacturer's full range]<Insert color and gloss>.

I. Single-Coat Superior Performance FEVE Organic Finish: Single-coat fluoroethylene vinyl ether (FEVE) fluoropolymer finish, complying with AAMA 2605. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: [As indicated by manufacturer's designations][Match Architect's sample][As selected by Architect from manufacturer's full range]<Insert color and gloss>.

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J. Two-Coat Superior Performance FEVE Organic Finish: Two-coat fluoroethylene vinyl ether (FEVE) fluoropolymer finish complying with AAMA 2605. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.

1. Color and Gloss: [As indicated by manufacturer's designations][Match Architect's sample][As selected by Architect from manufacturer's full range]<Insert color and gloss>.

2.8 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 with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces.
3. Remove embedded foreign matter and leave surfaces chemically clean.

C. Stainless Steel Pipe and Tubing Finishes:

1. 180-Grit Polished Finish: Uniform, directionally textured finish.
2. 320-Grit Polished Finish: Oil-ground, uniform, fine, directionally textured finish.
3. Polished and Buffed Finish: 320-grit finish followed by buffing [to a high luster finish][to a mirror-like finish][to match Architect's sample].

D. Stainless Steel Sheet and Plate Finishes:

1. Directional Satin Finish: ASTM A480/A480, No. 4.
2. High-Luster Finish: ASTM A480/A480M, No. 7.
3. Mirror Finish: ASTM A480/A480M, No. 8.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Perform cutting, drilling, and fitting required for installing railings.

1. Fit exposed connections together to form tight, hairline joints.
2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.

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3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
5. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

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. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws, using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending 2 inches beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within 6 inches of post.

3.4 ANCHORING POSTS

A. Use stainless steel pipe sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

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C. Cover anchorage joint with flange of same metal as post, [welded to post after placing anchoring material][attached to post with setscrews].

D. Leave anchorage joint exposed with [1/8-inch buildup, sloped away from post][anchoring material flush with adjacent surface].

E. Anchor posts to metal surfaces with flanges, angle type, or floor type, as required by conditions, connected to posts and to metal supporting members as follows:

1. For steel railings, weld flanges to post and bolt to metal supporting surfaces.
2. For aluminum railings, attach posts as indicated, using fittings designed and engineered for this purpose.
3. For stainless steel railings, weld flanges to post and bolt to supporting surfaces.

F. Install removable railing sections, where indicated, in slip-fit stainless steel sockets cast in concrete.

3.5 ATTACHING RAILINGS

A. Anchor railing ends to concrete and masonry with [sleeves concealed within][flanges connected to][brackets on underside of rails connected to] railing ends and anchored to wall construction with anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and [welded to railing ends][or][connected to railing ends, using nonwelded connections].

C. Attach handrails to walls with wall brackets [, except where end flanges are used]. Provide brackets with [1-1/2-inch]<Insert dimension> clearance from inside face of handrail and finished wall surface.

1. Use type of bracket with [flange tapped for concealed anchorage to threaded hanger bolt][predrilled hole for exposed bolt anchorage].
2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets [and railing end flanges] to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
4. For steel-framed partitions, use hanger or lag bolts set into [fire-retardant-treated] wood backing between studs. Coordinate with stud installation to locate backing members.
5. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements, using self-tapping screws of size and type required to support structural loads.
6. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

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E. Install railing gates level, plumb, and secure for full opening without interference.

1. Attach hardware using tamper-resistant or concealed means.
2. Adjust hardware for smooth operation.

3.6 REPAIR

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in [Section 099113 "Exterior Painting."][Section 099123 "Interior Painting."][Section 099600 "High-Performance Coatings."]

3.7 CLEANING

A. Clean [aluminum][and][stainless steel] by washing thoroughly with clean water and soap and rinsing with clean water.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

3.8 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 055213

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SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood products.
2. Wood-preservative-treated lumber.
3. Fire-retardant-treated lumber.
4. Dimension lumber framing.
5. Miscellaneous lumber.
6. Plywood backing panels.

B. Related Requirements:

1. Section 061533 "Wood Patio Decking" for elevated decks, including support framing.
2. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.
3. Section 061753 "Shop-Fabricated Wood Trusses" for wood trusses made from dimension lumber.
4. Section 064013 "Exterior Architectural Woodwork" for exterior wood stairs and railings.
5. Section 064023 "Interior Architectural Woodwork" for interior wood stairs and railings.
6. Section 313116 "Termite Control" for site application of borate treatment to wood framing.

1.2 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. Lumber grading agencies, and abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. SPIB: The Southern Pine Inspection Bureau.
4. WCLIB: West Coast Lumber Inspection Bureau.
5. WWPA: Western Wood Products Association.

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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 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 in accordance with ASTM D5664.
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.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates:

1. 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.
2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

1.5 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

A. Lumber: Comply with 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, omit grade

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stamp and provide certificates of grade compliance issued by grading agency.

3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
4. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content:

1. Boards: 15 percent.
2. Dimension Lumber: 15 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1, Use categories as follows:

1. UC1: Interior construction not in contact with ground or subject to moisture. Include [all rough carpentry.][the following items:]

    a. Wood sills, sleepers, blocking, [furring,][stripping,] and similar concealed members in contact with masonry or concrete.
    b. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
    c. Wood floor plates that are installed over concrete slabs-on-grade.
    d. Wood furniture.
    e. Wood millwork.
    f. <Insert item>.

2. UC2: Interior construction not in contact with ground but may be subject to moisture. Include [all rough carpentry.][the following items:]

    a. Wood sills, sleepers, blocking, [furring,][stripping,] and similar concealed members in contact with masonry or concrete.
    b. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
    c. Wood floor plates that are installed over concrete slabs-on-grade.
    d. Wood millwork.
    e. Wood flooring.
    f. <Insert item>.

3. UC3A (Commodity Specification A): Coated sawn products in exterior construction not in contact with ground but exposed to all weather cycles including intermittent wetting. Include [all rough carpentry.][the following items:]

    a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
    b. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
    c. Wood siding and trim.
    d. <Insert item>.

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4. UC3A (All Other Commodity Specifications): Coated products excluding sawn products in exterior construction not in contact with ground, exposed to all weather cycles but protected from liquid water. Include [all rough carpentry.][the following items:]

    a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
    b. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
    c. Wood floor plates that are installed over concrete slabs-on-grade.
    d. Wood siding and trim.
    e. Wood sheathing.
    f. <Insert item>.

5. UC3B (Commodity Specification A): Uncoated sawn products in exterior construction not in contact with ground, exposed to all weather cycles including intermittent wetting but with sufficient air circulation for wood to dry. Excludes sawn products not in contact with ground but with ground contact-type hazards. Include [all rough carpentry.][the following items:]

    a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
    b. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
    c. Wood decking, railings, and joists and beams for decks that are not critical to the performance and safety of the entire system/construction and that are in locations easily accessible for maintenance, repair, or replacement.
    d. <Insert item>.

6. UC3B (All Other Commodity Specifications): Uncoated products excluding sawn products in exterior construction not in contact with ground, exposed to all weather cycles including prolonged wetting. Include [all rough carpentry.][the following items:]

    a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
    b. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
    c. <Insert item>.

7. UC4A (Commodity Specification A): Non-critical sawn products in contact with ground and exposed to all weather cycles including continuous or prolonged wetting, and sawn products not in contact with ground but with ground contact-type hazards or that are critical or hard to replace. Include [all rough carpentry.][the following items:]

    a. Wood framing members that are less than 6 inches above the ground.

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b. Joists and beams when they are difficult to maintain, repair, or replace and are critical to the performance and safety of the entire system/construction.
c. <Insert item>.

8. UC4A (All Other Commodity Specifications): Non-critical products excluding sawn products in contact with ground and exposed to all weather cycles, normal exposure conditions. Include [all rough carpentry.][the following items:]

   a. <Insert item>.

9. UC4B (Commodity Specification A): Critical or difficult-to-replace sawn products in contact with ground and exposed to all weather cycles including continuous or prolonged wetting, high decay potential, and salt water splash. Include [all rough carpentry.][the following items:]

   a. Wood foundations.
   b. <Insert item>.

10. UC4B (All Other Commodity Specifications): Critical or difficult-to-replace products excluding sawn products in contact with ground and exposed to all weather cycles including high decay potential and salt water splash. Include [all rough carpentry.][the following items:]

    a. <Insert item>.

11. UC4C (Commodity Specification A): Critical structural sawn products in contact with ground and exposed to all weather cycles including continuous or prolonged wetting, severe environments, and extreme decay potential. Include [all rough carpentry.][the following items:]

    a. Wood foundation piling.
    b. <Insert item>.

12. UC4C (All Other Commodity Specifications): Critical structural products excluding sawn products in contact with ground and exposed to all weather cycles including severe environments and extreme decay potential. Include [all rough carpentry.][the following items:]

    a. Wood foundation piling.
    b. <Insert item>.

13. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. [Do not use inorganic boron (SBX) for sill plates.]
14. For exposed items indicated to receive a stained or natural finish, chemical formulations are not to require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
15. After treatment, redry [boards][dimension lumber] to 19 percent maximum moisture content.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not

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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.

D. Application: Treat [all rough carpentry unless otherwise indicated.][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 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.
6. <Insert item>.

2.3 FIRE-RETARDANT-TREATED LUMBER

A. General: Where fire-retardant-treated materials are indicated, materials are to 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 in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Treatment is not to promote corrosion of metal fasteners.
2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber is to be tested according to ASTM D5664 and design value adjustment factors are to be calculated according to ASTM D6841. [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

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extreme fiber in bending for Project's climatological zone.]

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. [Kiln-dry plywood after treatment to maximum moisture content of 15 percent.]

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency and other information required by authorities having jurisdiction.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

E. For exposed items indicated to receive a stained or natural finish, chemical formulations are not to bleed through, contain colorants, or otherwise adversely affect finishes.

F. Application: Treat [all rough carpentry unless otherwise indicated.][items indicated on Drawings, and the following:]

1. Framing for raised platforms.
2. Framing for stages.
3. Concealed blocking.
4. Framing for non-load-bearing partitions.
5. Framing for non-load-bearing exterior walls.
6. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
7. Plywood backing panels.
8. <Insert item>.

2.4 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions by Grade: Construction or No. 2 grade.

1. Application: [All interior partitions][Interior partitions not indicated as load bearing].
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. Northern species; NLGA.
g. Eastern softwoods; NeLMA.
h. Western woods; WCLIB or WWPA.

B. Load-Bearing Partitions by Grade: No. 2 grade.

1. Application: [Exterior walls][and][interior load-bearing partitions].
2. Species:

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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.

C. Machine Stress-Rated (MSR) Lumber Partitions: Any species of MSR dimension lumber with a grade of not less than [2400f-2.0E][2100f-1.8E][1650f-1.5E]<Insert grade>.

1. Application: [Exterior walls][and][interior load-bearing partitions].

D. Load-Bearing Partitions by Performance: Any species and grade with a modulus of elasticity of at least 1,500,000 psi and an extreme fiber stress in bending of at least 1000 psi for 2-inch nominal thickness and 12-inch nominal width for single-member use.

1. Application: [Exterior walls][and][interior load-bearing partitions].

E. Ceiling Joists: Construction or No. 2 grade.

1. Species:

a. Hem-fir (north); NLGA.
b. Southern pine; SPIB.
c. Douglas fir-larch; WCLIB or WWPA.
d. Douglas fir-larch (north); NLGA.
e. Southern pine or mixed southern pine; SPIB.
f. Spruce-pine-fir; NLGA.
g. Hem-fir; WCLIB or WWPA.
h. Douglas fir-south; WWPA.
i. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
j. Northern species; NLGA.
k. Eastern softwoods; NeLMA.
l. Western woods; WCLIB or WWPA.

F. Joists, Rafters, and Other Framing by Grade: No. 1 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.

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h. Douglas fir-larch (north); NLGA.
i. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

G. Joists, Rafters, and Other Framing by Performance: Any species and grade with a modulus of elasticity of at least 1,500,000 psi and an extreme fiber stress in bending of at least 1000 psi for 2-inch nominal thickness and 12-inch nominal width for single-member use.

H. Exposed Framing: Hand-select material [indicated to receive a stained or natural finish] 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:

a. As indicated above for load-bearing construction of same type.
b. Hem-fir (north); No. 1 grade; NLGA.
c. Southern pine; No. 1 grade; SPIB.
d. Douglas fir-larch; No. 1 grade; WCLIB or WWPA.
e. Mixed southern pine; No. 1 grade; SPIB.
f. Spruce-pine-fir; No. 1 grade; NLGA.
g. Douglas fir-south; No. 1 grade; WWPA.
h. Hem-fir; No. 1 grade; WCLIB or WWPA.
i. Douglas fir-larch (north); No. 1 grade; NLGA.
j. Spruce-pine-fir (south); No. 1 grade; NeLMA, WCLIB, or WWPA.
k. Eastern hemlock-balsam fir or eastern hemlock-tamarack; No. 1 grade; NeLMA.
l. Northern red oak; [Select Structural][No. 1] grade; NeLMA.
m. Redwood; [Clear Heart Structural][Clear Structural][Select Structural][No. 1] grade; RIS.
n. Mixed oak; [Select Structural][No. 1] grade; NeLMA.
o. Mixed maple; [Select Structural][No. 1] grade; NeLMA.
p. Western cedars; [Select Structural][No. 1] grade; WCLIB or WWPA.

2.5 MISCELLANEOUS LUMBER

A. 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 species.][any of the following species:][the following species:]

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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. 1 grade; SPIB.
3. Hem-fir or hem-fir (north); Select Merchantable or No. 1 Common grade; NLGA, WCLIB, or WWPA.
4. Spruce-pine-fir (south) or spruce-pine-fir; Select Merchantable or No. 1 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. Roofing Nailers: Structural- or No. 2-grade lumber or better; kiln-dried Douglas fir, southern pine, or wood having similar decay-resistant properties.

F. 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.

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.

2.6 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, [Exterior, A-C][Exterior, C-C Plugged][Exposure 1, C-D Plugged], fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

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2.7 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.

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 A153/A153M or ASTM F2329.
2. For redwood, use stainless steel fasteners.

B. Nails, Brads, and Staples: ASTM F1667.

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][ICC-ES AC58][ICC-ES AC193][or][ICC-ES AC308] as appropriate for the substrate.

2.8 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets:

1. Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.
2. Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.
3. Self-adhering sheet consisting of 64 mils of rubberized asphalt laminated on one side to a 4-mil- thick, polyethylene-film reinforcement, and with release liner on adhesive side [; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction].

B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

C. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

D. 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.

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PART 3 - EXECUTION

3.1 INSTALLATION

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set work 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.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. [Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.]

D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

E. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.

F. Install sill sealer gasket/termite barrier in accordance with manufacturer's written instructions at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

G. Do not splice structural members between supports unless otherwise indicated.

H. 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.

I. 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.

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J. 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.

K. 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.

L. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

M. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

N. Securely attach roofing nailers to substrates by anchoring and fastening to withstand bending, shear, or other stresses imparted by Project wind loads and fastener-resistance loads as designed in accordance with ASCE/SEI 7.

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.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

A. Install where indicated and where required for [screeding or] 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 wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Attach wood roofing nailers securely to substrate to resist the designed outward and upward wind loads indicated on Drawings and in accordance with ANSI/SPRI ED-1, Tables A6 and A7.

D. 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

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longer required.

3.3 INSTALLATION OF WOOD FURRING

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][and][vertically] at [24 inches][600 mm] o.c.

C. Furring to Receive Gypsum Board or Plaster Lath: Install 1-by-2-inch nominal- size furring vertically at [16 inches][400 mm] o.c.

3.4 INSTALLATION OF FLOOR JOIST FRAMING

A. General: Install floor joists with crown edge up and support ends of each member with not less than 1-1/2 inches of bearing on wood or metal, or 3 inches on masonry. Attach floor joists as follows:

1. Where supported on wood members, by [toe nailing or by] using metal framing anchors.
2. Where framed into wood supporting members, by using wood ledgers as indicated or, if not indicated, by using metal joist hangers.

B. Fire Cuts: At joists built into masonry, bevel cut ends 3 inches and do not embed more than 4 inches.

C. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 48 inches.

D. Do not notch in middle third of joists; limit notches to one-sixth depth of joist, one-third at ends. Do not bore holes larger than one-third depth of joist; do not locate closer than 2 inches from top or bottom.

E. Provide solid blocking of 2-inch nominal thickness by depth of joist at ends of joists unless nailed to header or band.

F. Lap members framing from opposite sides of beams, girders, or partitions not less than 4 inches or securely tie opposing members together. Provide solid blocking of 2-inch nominal thickness by depth of joist over supports.

G. Anchor members paralleling masonry with 1/4-by-1-1/4-inch metal strap anchors spaced not more than 96 inches o.c., extending over and fastening to three joists. Embed anchors at least 4 inches into grouted masonry with ends bent at right angles and extending 4 inches beyond bend.

H. Provide solid blocking between joists under jamb studs for openings.

I. Under non-load-bearing partitions, provide double joists separated by solid blocking

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equal to depth of studs above.

1. Provide triple joists separated as above, under partitions receiving ceramic tile and similar heavy finishes or fixtures.

J. Provide bridging of type indicated below, at intervals of 96 inches o.c., between joists.

1. Diagonal wood bridging formed from bevel-cut, 1-by-3-inch nominal- size lumber, double-crossed and nailed at both ends to joists.
2. Steel bridging installed to comply with bridging manufacturer's written instructions.

3.5 INSTALLATION OF CEILING JOIST AND RAFTER FRAMING

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 [toe nail or] 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 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.

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END OF SECTION 061000

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SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof sheathing.
2. Subflooring and underlayment.
3. Sheathing joint-and-penetration treatment materials.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for plywood backing panels.
2. Section 072500 "Weather Barriers" for water-resistive barrier applied over wall sheathing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]<Insert location>.

1. Review air-barrier and water-resistant glass-mat gypsum sheathing requirements and installation, special details, transitions, mockups, air-leakage testing, protection, and work scheduling that covers air-barrier and water-resistant glass-mat gypsum sheathing.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Wall sheathing.
2. Roof sheathing.
3. Parapet sheathing.
4. Composite nail base insulated roof sheathing.
5. Subflooring and underlayment.
6. Sheathing joint-and-penetration treatment materials.

B. Product Data Submittals: 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.

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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 in accordance with ASTM D5516.
4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. For air-barrier and water-resistant glass-mat gypsum sheathing, include manufacturer's technical data and tested physical and performance properties of products.

C. Sustainable Design Submittals:

1. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.

D. Shop Drawings: For air-barrier and water-resistant glass-mat gypsum sheathing assemblies.

1. Show locations and extent of sheathing, accessories, and assemblies specific to Project conditions.
2. Include details for sheathing joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer [, including list of ABAA-certified installers and supervisors employed by Installer, who work on Project][and][testing and inspecting agency].

B. Product Certificates: From air-barrier and water-resistant glass-mat gypsum sheathing manufacturer, certifying compatibility of sheathing accessory materials with Project materials that connect to or that come in contact with the sheathing.

C. Product Test Reports: For each air-barrier and water-resistant glass-mat gypsum sheathing assembly, indicating compliance with specified requirements, for tests performed by a qualified testing agency.

D. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated plywood.
2. Fire-retardant-treated plywood.
3. Foam-plastic sheathing.
4. Air-barrier and water-resistant glass-mat gypsum sheathing.

E. Field quality-control reports.

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1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer of air-barrier and water-resistant glass-mat gypsum sheathing.

1. Installer is to be licensed by ABAA in accordance with ABAA's Quality Assurance Program and is to employ ABAA-certified installers and supervisors on Project.

B. Mockups: Build mockups to set quality standards for materials and execution [and for preconstruction testing].

1. Build integrated mockups of exterior wall assembly [as indicated on Drawings][, 150 sq. ft.]<Insert requirement>, incorporating backup wall construction, window, storefront, door frame and sill, ties and other penetrations, and flashing to demonstrate crack and joint treatment and sealing of gaps, terminations, and penetrations of air-barrier sheathing assembly.

   a. Coordinate construction of mockups to permit inspection and testing of sheathing before external insulation and cladding are installed.
   b. Include junction with roofing membrane [, building corner condition,][and][foundation wall intersection].
   c. If Architect determines mockups do not comply with requirements, reconstruct mockups until mockups are approved.

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.

C. Testing Agency Qualifications:

1. 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.
2. For testing and inspecting agency providing tests and inspections related to air-barrier and water-resistant glass-mat gypsum sheathing: an independent agency, qualified in accordance with ASTM E329 for testing indicated, and certified by Air Barrier Association of America, Inc.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: [Owner will engage][Engage] a qualified testing agency to perform preconstruction testing on field mockups.

B. Mockup Testing: Air-barrier and water-resistant glass-mat gypsum sheathing assemblies are to comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.

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1. Air-Leakage-Location Testing: Mockups will be tested for evidence of air leakage in accordance with [ASTM E1186, chamber pressurization or depressurization with smoke tracers][ASTM E1186, chamber depressurization with detection liquids]<Insert requirement>.
2. Air-Leakage-Volume Testing: Mockups will be tested for air-leakage rate in accordance with [ASTM E783][or][ASTM E2357].
3. Notify Architect [seven]<Insert number> days in advance of the dates and times when mockups will be tested.

1.7 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 in accordance with ASTM E119; 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.

B. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing Performance: Air-barrier and water-resistant glass-mat gypsum sheathing assembly, and seals with adjacent construction, are to be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies are to be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations [, tie-ins to installed waterproofing][, tie-ins to other installed air barriers], and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.2 WOOD PANEL PRODUCTS

A. Emissions: Products are to meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

C. Factory mark panels to indicate compliance with applicable standard.

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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 all plywood unless otherwise indicated][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 in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet 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 are to comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber plywood is to be tested in accordance with ASTM D5516 and design value adjustment factors are to be calculated in accordance with ASTM D6305. Span ratings after treatment are to 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 are to 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

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qualified testing agency.

E. Application: [Treat all plywood unless otherwise indicated.][Treat plywood indicated on Drawings, and the following:]

1. Roof [and wall] sheathing within 48 inches of [fire][party] walls.
2. Roof sheathing.
3. Subflooring and underlayment for raised platforms.
4. <Insert category of plywood items required to be treated>.

2.5 WALL SHEATHING

A. Plywood Sheathing, Walls: [DOC PS 1][Either DOC PS 1 or DOC PS 2], [Exterior, Structural I][Exterior][Exposure 1, Structural I][Exposure 1] sheathing.

1. Span Rating: Not less than [16/0][20/0][24/0][32/16].
2. Nominal Thickness: Not less than [11/32 inch][3/8 inch][1/2 inch].

B. Oriented-Strand-Board Sheathing, Walls: DOC PS 2, [Exposure 1, Structural I][Exposure 1] sheathing.

1. Span Rating: Not less than [16/0][20/0][24/0][24/16][32/16].
2. Nominal Thickness: Not less than [5/16 inch][3/8 inch][1/2 inch].

C. Fiberboard Sheathing: ASTM C208, Type IV, [Grade 1 (Regular)][Grade 2 (Structural)] cellulosic fiberboard sheathing with square edges, [1/2 inch][25/32 inch] thick.

2.6 ROOF SHEATHING

A. Plywood Sheathing, Roofs: [DOC PS 1][Either DOC PS 1 or DOC PS 2], [Exterior, Structural I][Exterior][Exposure 1, Structural I][Exposure 1] sheathing.

1. Span Rating: Not less than [16/0][20/0][24/0][32/16][40/20][48/24].
2. Nominal Thickness: Not less than [15/32 inch][1/2 inch].

B. Oriented-Strand-Board Sheathing, Roofs: DOC PS 2, [Exposure 1, Structural I][Exposure 1] sheathing.

1. Span Rating: Not less than [16/0][20/0][24/0][24/16][32/16][40/20][48/24].
2. Nominal Thickness: Not less than [7/16 inch][15/32 inch][1/2 inch][5/8 inch][3/4 inch].

2.7 PARAPET SHEATHING

A. Plywood Sheathing, Parapets: [DOC PS 1][Either DOC PS 1 or DOC PS 2], [Exterior, Structural I][Exterior][Exposure 1, Structural I][Exposure 1] sheathing.

1. Span Rating: Not less than [16/0][20/0][24/0][32/16][40/20][48/24].

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2. Nominal Thickness: Not less than [15/32 inch][1/2 inch].

B. Oriented-Strand-Board Sheathing, Parapets: DOC PS 2, [Exposure 1, Structural I][Exposure 1] sheathing.

1. Span Rating: Not less than [16/0][20/0][24/0][24/16][32/16][40/20][48/24].
2. Nominal Thickness: Not less than [7/16 inch][15/32 inch][1/2 inch][5/8 inch][3/4 inch].

2.8 SUBFLOORING AND UNDERLAYMENT

A. Plywood Combination Subfloor-Underlayment: DOC PS 1, [Exterior, Structural I, C-C Plugged][Exterior, C-C Plugged][Exposure 1, Structural I, Underlayment][Exposure 1, Underlayment] single-floor panels.

1. Span Rating: Not less than [16][20][24][32][48].
2. Nominal Thickness: Not less than [23/32 inch][7/8 inch][1 inch].
3. Edge Detail: [Square][Tongue and groove].
4. Surface Finish: Fully sanded face.

B. Oriented-Strand-Board Combination Subfloor-Underlayment: DOC PS 2, Exposure 1 single-floor panels.

1. Span Rating: Not less than [16][20][24][32][48].
2. Nominal Thickness: Not less than [23/32 inch][7/8 inch][1 inch].
3. Edge Detail: [Square][Tongue and groove].
4. Surface Finish: [Fully sanded][Resin-impregnated overlay] face.

C. Plywood Subflooring: [DOC PS 1][Either DOC PS 1 or DOC PS 2], [Exterior, Structural I][Exterior][Exposure 1, Structural I][Exposure 1] single-floor panels or sheathing.

1. Span Rating: Not less than [16][20][24][32][48][or][32/16][40/20][48/24].
2. Nominal Thickness: Not less than [23/32 inch][7/8 inch][1 inch].

D. Oriented-Strand-Board Subflooring: DOC PS 2, Exposure 1 [, Structural I sheathing][single-floor panels or sheathing].

1. Span Rating: Not less than [16][20][24][32][48][or][32/16][40/20][48/24][60/32].
2. Nominal Thickness: Not less than [23/32 inch][7/8 inch][1 inch].

E. Underlayment: Provide underlayment in nominal thicknesses indicated or, if not indicated, not less than 1/4 inch over smooth subfloors and not less than 3/8 inch over board or uneven subfloors.

1. Plywood Underlayment for Resilient Flooring: DOC PS 1, [Exterior A-C][Exterior B-C][Exterior, C-C Plugged][Exposure 1 Underlayment] with fully sanded face.
2. Plywood Underlayment for Ceramic Tile: DOC PS 1, Exterior, C-C Plugged, not less than 5/8-inch nominal thickness.
3. Plywood Underlayment for Carpet: DOC PS 1, [Exterior, C-C Plugged][Exposure 1, Underlayment][Interior, Underlayment].

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4. Particleboard Underlayment: ANSI A208.1, [Grade PBU][Grade M-2].
5. Hardboard Underlayment: ANSI A135.4, Class 4 (Service), Surface S1S; with back side sanded.

2.9 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For [roof][parapet][and][wall] sheathing, provide fasteners [with hot-dip zinc coating complying with ASTM A153/A153M][of Type 304 stainless steel].
2. For [roof][parapet][and][wall] sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours in accordance with ASTM B117.

B. Nails, Brads, and Staples: ASTM F1667.

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 C1002.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, 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 C1002.
2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C954.

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 in accordance with ASTM B117. Provide washers or plates if recommended by sheathing manufacturer.

2.10 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Paper-Surfaced and 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."

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B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, 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.

2.11 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with [APA AFG-01][ASTM D3498] that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

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 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

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][parapet][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

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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 INSTALLATION OF WOOD STRUCTURAL PANEL

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][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][Nail][Nail or staple] 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][Nail or staple] to wood framing. [Apply a continuous bead of glue to framing members at edges of wall sheathing panels.]
    b. Screw to cold-formed metal framing.
    c. Space panels 1/8 inch apart at edges and ends.

4. Underlayment:

    a. [Nail][Nail or staple] 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 INSTALLATION OF GYPSUM SHEATHING

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

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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 in accordance with sheathing manufacturer's written instructions.

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 INSTALLATION OF CEMENTITIOUS BACKER UNITS

A. Install panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.5 INSTALLATION OF FIBERBOARD SHEATHING

A. Comply with ASTM C846 and with manufacturer's written instructions.

B. Fasten fiberboard sheathing panels to intermediate supports and then at edges and ends. Use galvanized roofing nails [or galvanized staples]; comply with manufacturer's recommended spacing and referenced fastening schedule. Drive fasteners flush with

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surface of sheathing and locate perimeter fasteners at least 3/8 inch from edges and ends.

C. Install sheathing vertically with long edges parallel to, and centered over, studs. Install solid wood blocking where end joints do not occur over framing. Allow 1/8-inch open space between edges and ends of adjacent units. Stagger horizontal joints if any.

D. Cover sheathing as soon as practical after installation to prevent deterioration from wetting.

3.6 INSTALLATION OF FOAM-PLASTIC SHEATHING

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.

3.7 INSTALLATION OF PARTICLEBOARD UNDERLAYMENT

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][Nail][Nail or staple] underlayment to subflooring.

3.8 INSTALLATION OF HARDBOARD UNDERLAYMENT

A. Comply with CPA's recommendations and hardboard manufacturer's written instructions for preparing and applying hardboard underlayment.

1. Fastening Method: [Nail][Nail or staple] underlayment to subflooring.

3.9 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

B. Testing and Inspecting Agency: [Owner will engage][Engage] a qualified testing agency to perform tests and inspections.

C. Inspections: Air-barrier and water-resistant glass-mat gypsum sheathing, accessories, and installation are subject to inspection for compliance with requirements. [

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Inspections may include the following:]

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
3. Termination mastic has been applied on cut edges.
4. Strips and transition strips have been firmly adhered to substrate.
5. Compatible materials have been used.
6. Transitions at changes in direction and structural support at gaps have been provided.
7. Connections between assemblies (sheathing and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
8. All penetrations have been sealed.

D. Tests: As determined by testing agency from among the following tests:

1. Air-Leakage-Location Testing: Air-barrier sheathing assemblies will be tested for evidence of air leakage in accordance with [ASTM E1186, chamber pressurization or depressurization with smoke tracers][ASTM E1186, chamber depressurization using detection liquids]<Insert requirement>.
2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate in accordance with [ASTM E783][or][ASTM E2357].

E. Air barriers will be considered defective if they do not pass tests and inspections.

F. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

G. Prepare test and inspection reports.

END OF SECTION 061600

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SECTION 062013 - EXTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior trim.
2. Lumber siding.
3. Lumber soffits.

1.2 DEFINITIONS

A. MDO: Plywood with a medium-density overlay on the face.

B. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors 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. Include chemical-treatment manufacturer's written instructions for finishing treated material.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.

B. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party Certified Life Cycle Assessment: For each product.
3. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.

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

D. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.

E. Samples for Verification:

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1. For each species and cut of lumber and panel products, with half of exposed surface finished; 50 sq. in. for lumber and 8 by 10 inches for panels.
2. For engineered wood [siding][and][soffits], 50 sq. in. for board types and 8 by 10 inches for panels.
3. For cellular PVC trim, with half of exposed surface finished; 50 sq. in..
4. For foam-plastic moldings, with half of exposed surface finished; 50 sq. in..

1.4 INFORMATIONAL SUBMITTALS

A. Compliance Certificates:

1. For lumber that is not marked with grade stamp.
2. For preservative-treated wood that is not marked with treatment-quality mark.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Cellular PVC trim.
3. Foam-plastic moldings.

C. Sample Warranties: For manufacturer's warranties.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation.

1. Protect materials from weather by covering with waterproof sheeting, securely anchored.
2. Provide for air circulation around stacks and under coverings.

1.6 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least one coat of specified finish can be applied without exposure to rain, snow, or dampness.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

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1.7 WARRANTY

A. Engineered Wood Manufacturer's Warranty: Manufacturer agrees to repair or replace components of engineered wood siding [soffits][and][trim] that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, deformation or deterioration beyond normal weathering.
2. Warranty Period for Factory-Applied Finish: [Five]<Insert number> years from date of Substantial Completion.
3. Warranty Period: Siding [Soffits][and][Trim] (Excluding Finish), [25]<Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of inspection agency, indicating grade, species, moisture content at time of surfacing, and mill.
2. For exposed lumber, mark grade stamp on end or back of each piece [, or omit grade stamp and provide certificates of grade compliance issued by inspection agency].

B. Softwood Plywood: DOC PS 1.

C. Hardboard: ANSI A135.4.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Water-Repellent Preservative Treatment by Nonpressure Process: AWPA N1; dip, spray, flood, or vacuum-pressure treatment.

1. Preservative Chemicals: 3-iodo-2-propynyl butyl carbamate (IPBC) [, combined with an insecticide containing chloropyrifos (CPF)]<Insert requirement>.
2. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.
3. Application: [Items not required to be pressure-preservative treated][Exterior trim][and][wood siding]<Insert application>.

B. Preservative Treatment by Pressure Process: AWPA U1; Use Category [UC3a][UC3b].

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1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 18 percent, respectively.
2. Preservative Chemicals: Acceptable to authorities having jurisdiction [and containing no arsenic or chromium].
3. For exposed items indicated to receive transparent finish, do not use chemical formulations that contain colorants or that bleed through or otherwise adversely affect finishes.
4. Do not use material that is warped or does not comply with requirements for untreated material.
5. Mark lumber with treatment-quality mark of an inspection agency approved by the ALSC's Board of Review.

    a. 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].

6. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

    a. For exposed plywood indicated to receive a stained or natural finish, mark back of each piece.

7. Application: [Where indicated on Drawings][All exterior lumber and plywood]<Insert application>.

2.3 EXTERIOR TRIM

A. MDO Trim: Exterior Grade B-B MDO plywood.

B. Primed Hardboard Trim: ANSI A135.6, primed with manufacturer's standard exterior primer. Recommended by manufacturer for exterior use.

2.4 MISCELLANEOUS MATERIALS

A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1-1/2 inches into wood substrate.

1. For face-fastening siding, provide ringed-shank siding nails [or hot-dip galvanized-steel siding nails][unless otherwise indicated].
2. For redwood, provide [stainless steel][hot-dip galvanized-steel] fasteners.
3. For prefinished items, provide matching prefinished aluminum fasteners where face fastening is required.
4. For pressure-preservative-treated wood, provide [stainless steel][hot-dip galvanized-steel] fasteners.
5. For applications not otherwise indicated, provide [stainless steel][hot-dip galvanized-steel][or][aluminum] fasteners.

B. Wood Glue: Waterproof resorcinol glue recommended by manufacturer for exterior carpentry use.

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C. Adhesive for Cellular PVC Trim: Product recommended by trim manufacturer.

D. Flashing: Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim" for flashing materials installed in exterior finish carpentry.

1. Horizontal Joint Flashing for Panel Siding: Preformed, [galvanized-steel][aluminum][prefinished-aluminum][stainless steel], Z-shaped flashing.

E. Insect Screening for Soffit Vents: Stainless steel, 18-by-18-inch mesh.

F. Continuous Soffit Vents: Aluminum hat channel shape with [stamped louvers][perforations], 2 inches wide and in lengths not less than 96 inches.

1. Net-Free Area: 4 sq. in./linear ft..
2. Finish: [Mill finish][White paint][Brown paint]<Insert description>.

2.5 FABRICATION

A. Back out or kerf backs of standing and running trim wider than 5 inches, except members with ends exposed in finished work.

B. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

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

3.2 PREPARATION

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

B. Prime lumber and moldings to be painted, including both faces and edges, unless factory primed.

1. Cut to required lengths and prime ends.
2. Comply with requirements in Section 099113 "Exterior Painting."

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3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.

1. Do not use manufactured units with defective surfaces, sizes, or patterns.

B. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials.

1. Use concealed shims where necessary for alignment.
2. Scribe and cut exterior finish carpentry to fit adjoining work.
3. Refinish and seal cuts as recommended by manufacturer.
4. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
5. Coordinate exterior finish carpentry with materials and systems in or adjacent to it.
6. Provide cutouts for mechanical and electrical items that penetrate exterior finish carpentry.

3.4 INSTALLATION OF STANDING AND RUNNING TRIM

A. Install flat-grain lumber with bark side exposed to weather.

B. Install cellular PVC trim to comply with manufacturer's written instructions.

C. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary.

1. Use scarf joints for end-to-end joints.
2. Stagger end joints in adjacent and related members.

D. Fit exterior joints to exclude water.

1. Cope at returns and miter at corners to produce tight-fitting joints, with full-surface contact throughout length of joint.
2. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.

E. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.

3.5 INSTALLATION OF SIDING

A. Install siding to comply with manufacturer's written instructions [and warranty requirements].

B. Horizontal Lumber Siding:

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1. Apply starter strip along bottom edge of sheathing or sill.
2. Install first course of siding, with lower edge at least 1/8 inch below starter strip and subsequent courses lapped 1 inch over course below.

    a. Nail at each stud.
    b. Do not allow nails to penetrate more than one thickness of siding.

3. Leave 1/8-inch gap at trim and corners unless otherwise recommended by manufacturer, and apply sealant.
4. Butt joints only over framing or blocking, nailing top and bottom on each side and staggering joints in subsequent courses.
5. Install prefabricated outside corners as recommended by manufacturer of siding materials.

C. Diagonal Lumber Siding:

1. Begin application at corner, with tongue edge up.
2. Install subsequent courses with tongue-and-groove edges tightly fitted together.

    a. Nail at each stud.

3. Leave 1/8-inch gap at trim and corners unless otherwise recommended by manufacturer, and apply sealant.
4. Butt joints only over framing or blocking, nailing top and bottom on each side and staggering joints in subsequent courses.
5. Install prefabricated outside corners as recommended by manufacturer of siding materials.

D. Flashing: Install metal flashing as indicated on Drawings and as recommended by siding manufacturer.

E. Finish: Apply finish within two weeks of installation.

3.6 ADJUSTING

A. Replace exterior finish carpentry that is damaged or does not comply with requirements.

1. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

B. Adjust joinery for uniform appearance.

3.7 CLEANING

A. Clean exterior finish carpentry on exposed and semiexposed surfaces.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

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3.8 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 062013

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SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior trim.
2. Shelving and clothes rods.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view and for framing exposed to view.
2. Section 064023 "Interior Architectural Woodwork" for shop-fabricated carpentry.
3. Section 099123 "Interior Painting" for priming and backpriming of interior finish carpentry.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Interior trim.
2. Paneling.
3. Shelving and clothes rods.

B. Product Data Submittals: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors 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. Include chemical-treatment manufacturer's written instructions for finishing treated material.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.

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

D. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.

E. Samples for Verification:

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1. For each species and cut of lumber and panel products with nonfactory-applied finish, with half of exposed surface finished; 50 sq. in. for lumber and 8 by 10 inches for panels.
2. For foam-plastic moldings, with half of exposed surface finished; 50 sq. in..
3. For each finish system and color of lumber and panel products with factory-applied finish, 50 sq. in. for lumber and 8 by 10 inches for panels.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation.

1. Protect materials from weather by covering with waterproof sheeting, securely anchored.
2. Provide for air circulation around stacks and under coverings.

B. Deliver interior finish carpentry materials only when environmental conditions comply with requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions comply with requirements specified for installation areas.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet-work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's 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.

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2. For exposed lumber, mark grade stamp on end or back of each piece , or omit grade stamp and provide certificates of grade compliance issued by grading agency.

B. Softwood Plywood: DOC PS 1.

C. Hardboard: ANSI A135.4.

D. MDF: ANSI A208.2, Grade 130.

E. Particleboard: ANSI A208.1, Grade M-2.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC1.

1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 18 percent, respectively.
2. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
3. For exposed items indicated to receive transparent finish, do not use chemical formulations that contain colorants or that bleed through or otherwise adversely affect finishes.
4. Do not use material that is warped or does not comply with requirements for untreated material.
5. Mark lumber with treatment-quality mark of an inspection agency approved by the ALSC's Board of Review.

    a. For exposed lumber indicated to receive a stained or natural finish, omit marking and provide certificates of treatment compliance issued by inspection agency.

6. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

    a. For exposed plywood indicated to receive a stained or natural finish, mark back of each piece.

7. Application: Where indicated on Drawings.

2.3 INTERIOR TRIM

A. Softwood Lumber Trim for Transparent Finish (Stain or Clear Finish):

1. Species and Grade:

    a. Eastern white pine; NeLMA or NLGA C Select.
    b. Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NLGA or WWPA C Select (Choice).

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c. Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NeLMA, NLGA, or WWPA C Select (Choice).
d. White woods; WWPA C Select.
e. Douglas fir-larch or Douglas fir south; NLGA, WCLIB, or WWPA Superior or C & Btr finish.
f. Southern pine; SPIB B & B finish.
g. Western red cedar; NLGA, WCLIB, or WWPA [Clear Heart][Grade A][Grade B].

2. Maximum Moisture Content: 19 percent with at least 85 percent of shipment at 12 percent or less.
3. Finger Jointing: Allowed.
4. Face Surface: Surfaced (smooth).

B. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):

1. Species and Grade: White maple; NHLA Clear.
2. Maximum Moisture Content: 10 percent.
3. Finger Jointing: Not allowed.
4. Gluing for Width: Allowed.
5. Veneered Material: Allowed.
6. Face Surface: Surfaced (smooth).
7. Matching: Selected for compatible grain and color.

C. Lumber Trim for Opaque Finish (Painted Finish):

1. Species and Grade:

a. Eastern white pine; NeLMA or NLGA D Select.
b. Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NLGA or WWPA D Select (Quality).
c. Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NeLMA, NLGA, or WWPA D Select (Quality).
d. White woods; WWPA D Select.
e. Douglas fir-larch or Douglas fir south; NLGA, WCLIB, or WWPA Superior or C & Btr finish.
f. Spruce-pine-fir; NeLMA, NLGA, WCLIB, or WWPA 1 Common.
g. Alder, aspen, basswood, cottonwood, gum, magnolia, soft maple, sycamore, tupelo, or yellow poplar; NHLA A Finish.

2. Maximum Moisture Content for Softwoods: 19 percent with at least 85 percent of shipment at 12 percent or less.
3. Maximum Moisture Content for Hardwoods: 10 percent.
4. Finger Jointing: Allowed.
5. Face Surface: Surfaced (smooth).
6. Optional Material: Primed MDF of same actual dimensions as lumber indicated may be used in lieu of lumber.

D. Softwood Moldings for Transparent Finish (Stain or Clear Finish): MMPA WM 4, N-grade wood moldings. Made to patterns included in MMPA's "WM/Series Softwood

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Moulding Patterns."

1. Species: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine.
2. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
3. Finger Jointing: Not allowed.
4. Matching: Selected for compatible grain and color.
5. Base Pattern: [WM 623, 9/16-by-3-1/4-inch ogee][WM 713, 9/16-by-3-1/4-inch ranch][WM 753, 9/16-by-3-1/4-inch beaded-edge][WM 620, 9/16-by-4-1/4-inch ogee][WM 750, 9/16-by-4-1/4-inch beaded-edge] base.
6. Shoe-Mold Pattern: [WM 129, 7/16-by-11/16-inch quarter-round][WM 126, 1/2-by-3/4-inch quarter-round][WM 131, 1/2-by-3/4-inch ogee] shoe mold.
7. Casing Pattern: [WM 327, 11/16-by-2-1/4-inch clamshell][WM 366, 11/16-by-2-1/4-inch featheredge][WM 376, 11/16-by-2-1/4-inch beaded-edge] casing.
8. Mull-Casing Pattern: [WM 957, 3/8-by-1-3/4-inch beaded-edge][WM 973, 3/8-by-1-3/4-inch bullnose][WM 983, 3/8-by-1-3/4-inch featheredge] casing.
9. Stop Pattern: [WM 856, 3/8-by-1-3/8-inch ranch][WM 946, 3/8-by-1-3/8-inch ogee][WM 886, 3/8-by-1-3/8-inch bullnose] stop.
10. Chair-Rail Pattern: WM 297, 11/16-by-3-inch chair rail.

E. Hardwood Moldings for Transparent Finish (Stain or Clear Finish): MMPA WM 4, N-grade wood moldings made to patterns included in MMPA's "HWM/Series Hardwood Moulding Patterns."

1. Species: White maple.
2. Maximum Moisture Content: 9 percent.
3. Finger Jointing: Not allowed.
4. Matching: Selected for compatible grain and color.
5. Optional Material: Kiln-dried softwood or MDF, with exposed surfaces veneered with species indicated, may be used in lieu of solid wood.
6. Base Pattern: [HWM 633, 7/16-by-3-1/4-inch ogee][HWM 713, 7/16-by-3-1/4-inch ranch][HWM 753, 7/16-by-3-1/4-inch beaded-edge][WM 620, 7/16-by-4-1/4-inch ogee] base.
7. Shoe-Mold Pattern: [HWM 129, 7/16-by-11/16-inch quarter-round][HWM 126, 1/2-by-3/4-inch quarter-round][HWM 131, 1/2-by-3/4-inch ogee] shoe mold.
8. Casing Pattern: [HWM 328, 1/2-by-2-1/4-inch clamshell][HWM 366, 1/2-by-2-1/4-inch featheredge][HWM 376, 1/2-by-2-1/4-inch beaded-edge] casing.
9. Mull-Casing Pattern: [HWM 989, 3/16-by-2-inch square-edge][HWM 988, 3/8-by-1-1/2-inch featheredge][HWM 987, 3/8-by-2-inch featheredge] casing.
10. Stop Pattern: [HWM 856, 3/8-by-1-3/8-inch ranch][HWM 946, 3/8-by-1-3/8-inch ogee][HWM 886, 3/8-by-1-3/8-inch bullnose] stop.
11. Chair-Rail Pattern: HWM 297, 11/16-by-3-inch chair rail.

F. Moldings for Opaque Finish (Painted Finish): Made to patterns included in MMPA's "WM/Series Softwood Moulding Patterns."

1. Softwood Moldings: MMPA WM 4, P grade.

    a. Species: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or

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sugar pine.
b. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.

2. Hardwood Moldings: MMPA WM 4, P-grade.

a. Species: Aspen, basswood, cottonwood, gum, magnolia, soft maple, tupelo, or yellow poplar.
b. Maximum Moisture Content: 9 percent.

3. Finger Jointing: Allowed.
4. Optional Material: Primed MDF.
5. Base Pattern: WM 620, 9/16-by-4-1/4-inch ogee base.
6. Shoe-Mold Pattern: WM 129, 7/16-by-11/16-inch quarter-round shoe mold.
7. Casing Pattern: WM 376, 11/16-by-2-1/4-inch beaded-edge casing.
8. Mull-Casing Pattern: [WM 957, 3/8-by-1-3/4-inch beaded-edge][WM 973, 3/8-by-1-3/4-inch bullnose][WM 983, 3/8-by-1-3/4-inch featheredge] casing.
9. Stop Pattern: [WM 856, 3/8-by-1-3/8-inch ranch][WM 946, 3/8-by-1-3/8-inch ogee][WM 886, 3/8-by-1-3/8-inch bullnose] stop.
10. Chair-Rail Pattern: WM 297, 11/16-by-3-inch chair rail.

2.4 SHELVING AND CLOTHES RODS

A. Shelving: Closet shelving, made from the following material, 3/4 inch thick:

1. Particleboard with solid-wood front edge.
2. MDF with solid-wood front edge.
3. MDO softwood plywood with solid-wood edge.
4. Melamine-faced particleboard with radiused and filled front edge.
5. Wood boards as specified above for [lumber trim for opaque][softwood lumber trim for transparent][hardwood lumber trim for transparent] finish.
6. Softwood Boards:

a. Kiln-dried eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NeLMA, NLGA, or WWPA C Select (Choice).
b. Kiln-dried Douglas fir-larch, Douglas fir south, or hem-fir; SPIB Superior or C & Btr finish; NLGA, WCLIB, or WWPA; or southern pine; [B & B][C] finish.

B. Shelf Cleats: 3/4-by-5-1/2-inch boards with hole and notch to receive clothes rods, as specified above for shelving.

C. Standards for Adjustable Shelf Brackets: BHMA A156.9, B04102; powder-coat-finished steel.

D. Adjustable Shelf Brackets: BHMA A156.9, B04112; powder-coat-finished steel.

E. Standards for Adjustable Shelf Supports: BHMA A156.9, B04071; powder-coat-finished steel.

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F. Adjustable Shelf Supports: BHMA A156.9, B04081 or B04091; powder-coat-finished steel.

G. Wood Clothes Rods: 1-1/2-inch- diameter, clear, kiln-dried [hardwood][Douglas fir or southern pine].

H. Metal Clothes Rods: 1-5/16-inch- diameter, chrome-plated-steel tubes.

I. Wood Rod Flanges: Clear, kiln-dried, [Douglas fir or southern pine][eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine][red oak][white maple][aspen, basswood, cottonwood, sap gum, white maple, or yellow poplar]<Insert species> turnings [with clear finish].

J. Metal Rod Flanges: Chrome-plated steel.

2.5 MISCELLANEOUS MATERIALS

A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

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

C. Installation Adhesive for Foam-Plastic Moldings: Product recommended for indicated use by foam-plastic molding manufacturer.

1. Adhesives shall have a VOC content of 50 g/L or less.

D. Multipurpose Construction Adhesive: Formulation, complying with ASTM D3498, that is recommended for indicated use by adhesive manufacturer.

1. Adhesives shall have a VOC content of 70 g/L or less.

2.6 FABRICATION

A. Back out or kerf backs of the following members, except those with ends exposed in finished work:

1. Interior standing and running trim, except shoe and crown molds.
2. Wood-board paneling.

B. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

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

3.2 PREPARATION

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

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

3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound; warped; improperly treated or finished; inadequately seasoned; too small to fabricate with proper jointing arrangements; or with defective surfaces, sizes, or patterns.

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

1. Use concealed shims where necessary for alignment.
2. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
3. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
4. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.4 INSTALLATION OF INTERIOR TRIM

A. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available.

1. Do not use pieces less than 24 inches long, except where necessary.
2. Stagger joints in adjacent and related standing and running trim.

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3. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint.
4. Use scarf joints for end-to-end joints.
5. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
6. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
7. Install trim after gypsum-board joint finishing operations are completed.
8. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting.
9. Fasten to prevent movement or warping.
10. Countersink fastener heads on exposed carpentry work and fill holes.

3.5 INSTALLATION OF SHELVING AND CLOTHES RODS

A. Cut shelf cleats at ends of shelves about 1/2 inch less than width of shelves and sand exposed ends smooth.

1. Install shelf cleats by fastening to framing or backing with finish nails or trim screws, set below face and filled.
2. Space fasteners not more than 16 inches o.c. Use two fasteners at each framing member or fastener location for cleats 4 inches nominal in width and wider.
3. Apply a bead of multipurpose construction adhesive to back of shelf cleats before installing.
4. Remove adhesive that is squeezed out after fastening shelf cleats in place.

B. Install shelf brackets according to manufacturer's written instructions, spaced not more than 32 inches o.c. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.

C. Install standards for adjustable shelf supports according to manufacturer's written instructions. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors. Space fasteners not more than 12 inches o.c.

D. Install standards for adjustable shelf brackets according to manufacturer's written instructions, spaced not more than 36 inches o.c. and within 6 inches of ends of shelves. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.

E. Cut shelves to neatly fit openings with only enough gap to allow shelves to be removed and reinstalled.

1. Install shelves, fully seated on cleats, brackets, and supports.
2. Fasten shelves to cleats with finish nails or trim screws, set flush.
3. Fasten shelves to brackets to comply with bracket manufacturer's written instructions.

F. Install rod flanges for rods as indicated.

1. Fasten to shelf cleats, framing members, blocking, or metal backing, or use

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toggle bolts or hollow wall anchors.
2. Install rods in rod flanges.

3.6 ADJUSTING

A. Replace interior finish carpentry that is damaged or does not comply with requirements.

1. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

B. Adjust joinery for uniform appearance.

3.7 CLEANING

A. Clean interior finish carpentry on exposed and semiexposed surfaces.

B. Restore damaged or soiled areas and touch up factory-applied finishes if any.

3.8 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 062023

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SECTION 064013 - EXTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior standing and running trim for transparent finish.
2. Exterior standing and running trim for opaque finish.
3. Exterior frames and jambs for transparent finish.
4. Exterior frames and jambs for opaque finish.
5. Exterior shutters for transparent finish.
6. Exterior shutters for opaque finish.
7. Exterior stairs and railings.
8. Preservative-treated-wood material.
9. Fire-retardant-treated wood material.
10. Shutter hardware.
11. Miscellaneous materials.
12. Shop priming.
13. Shop finishing.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing exterior architectural woodwork that are concealed within other construction before exterior architectural woodwork installation.
2. Section 062013 "Exterior Finish Carpentry" for exterior carpentry exposed to view that is not specified in this Section.

1.2 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections, to ensure that exterior architectural woodwork can be supported and installed as indicated.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]<Insert location>.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

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B. Wood-Preservative Treatment:

1. Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
2. Indicate type of preservative used and net amount of preservative retained.
3. Include chemical-treatment manufacturer's written instructions for finishing treated material and manufacturer's written warranty.

C. Fire-Retardant Treatment: Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

D. Waterborne Treatments: For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

E. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party Certified Life Cycle Assessment: For each product.
3. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.

F. Shop Drawings:

1. Include dimensioned plans, elevations, sections, and attachment details.
2. Show [large-scale][full-size] details.
3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.
4. Apply [AWI Quality Certification][WI Certified Compliance] Program label to Shop Drawings.

G. Samples: For each exposed product and for each color and finish specified.

1. Size:

a. Panel Products: 12 inches by 12 inches.
b. Lumber Products: Not less than [5 inches wide by 12 inches long][5 inches wide by 24 inches long], for each species and cut, finished on one side and one edge.

H. Samples for Initial Selection: For each type of exposed finish.

1. Size:

a. Panel Products: 12 inches by 12 inches.
b. Lumber Products: Not less than [5 inches wide by 12 inches long][5 inches wide by 24 inches long], for each species and cut, finished on one side and one edge.

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I. Samples for Verification: For the following:

1. Lumber for Exterior Wood-Stain Finish: Not less than 5 inches wide by 12 inches long, for each species, with one-half of exposed surface finished.
2. Lumber for Transparent Finish: Not less than [5 inches wide by 12 inches long][5 inches wide by 24 inches long], for each species and cut, finished on one side and one edge.
3. Lumber and Panel Products with Shop-Applied Opaque Finish: 5 inches wide by 12 inches long for lumber and [8 by 10 inches][12 by 12 inches] for panels, for each finish system and color.

    a. Finish [entire][one-half of] exposed surface.

4. Shutter Hardware: Full-size samples for each type and size of hardware in each finish, and color required.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For [architectural woodwork manufacturer][and][Installer].

B. Evaluation Reports: For [preservative-treated][and][fire-retardant-treated] wood materials, from ICC-ES.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: [AWI Quality Certification Program][WI Certified Compliance Program] certificates.

1.7 QUALITY ASSURANCE

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

1. Manufacturer's Certification: Licensed participant in [AWI's Quality Certification Program][WI's Certified Compliance Program].

B. Installer Qualifications: [Fabricator of products][Licensed participant in AWI's Quality Certification Program][Licensed participant in WI's Certified Compliance Program].

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups of [typical exterior architectural woodwork as shown on Drawings]<Insert description>.
2. Approval of mockups does not constitute approval of deviations from the

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Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with Architectural Woodwork Standards, Section 2.

B. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1. Handle and store fire-retardant-treated wood to comply with chemical-treatment manufacturer's written instructions.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation of exterior architectural woodwork only when existing and forecasted weather conditions permit work to be performed and at least one coat of specified finish to be applied without exposure to rain, snow, or dampness.

B. Field Measurements: Where exterior architectural woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being concealed by construction, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where exterior architectural woodwork 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.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL WOODWORK MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

1. <Insert, in separate subparagraphs, names for preapproved architectural woodworking firms>.

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2.2 ARCHITECTURAL WOODWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of exterior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. Provide [labels][and][certificates] from AWI certification program indicating that woodwork [and installation] complies with requirements of grades specified.

    a. This project has been registered with AWI as AWI Quality Certification Program Number <Insert number>.
    b. Contractor is to register the Work under this Section with the AWI Quality Certification Program at www.awiqcp.org or by calling 800-345-0991.

2. The Contract Documents contain requirements that are more stringent than the Architectural Woodwork Standards. Comply with Contract Documents and the Architectural Woodwork Standards.

2.3 WOOD MATERIALS

A. Hardboard: ANSI A135.4.

B. Softwood Plywood: DOC PS 1, exterior [, medium-density overlay].

2.4 PRESERVATIVE-TREATED-WOOD MATERIAL

A. Preservative-Treated-Wood Materials: Provide with water-repellent preservative treatment complying with AWPA N1 (dip, spray, flood, or vacuum-pressure treatment).

1. Preservative Chemicals: 3-iodo-2-propynyl butyl carbamate (IPBC) [, combined with a compatible EPA-registered insecticide].
2. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.

B. Extent of Preservative-Treated Wood Materials: Treat wood materials [unless otherwise indicated on Drawings][except items indicated to be fire-retardant treated]<Insert requirements>.

1. Items fabricated from the following wood species need not be treated:

    a. [Redwood][All-heart redwood].
    b. [Western red cedar][All-heart western red cedar].
    c. White oak.
    d. African mahogany.
    e. Honduras mahogany.
    f. Ipe.
    g. Dark red meranti.
    h. Teak.

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2.5 FIRE-RETARDANT-TREATED WOOD MATERIAL

A. Fire-Retardant-Treated Wood Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products according to test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of the Architectural Woodwork Standards for the grade specified. Do not use materials that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

B. Exterior Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E84 after being subjected to accelerated weathering according to ASTM D2898, 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. Kiln-dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
2. For items indicated to receive a stained, transparent, or natural finish, use organic resin chemical formulation.
3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
4. Mill lumber before treatment and implement procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.

C. Extent of Fire-Retardant-Treated Wood Materials:

1. Exterior architectural woodwork located more than 40 feet above grade.
2. Exterior architectural woodwork in locations with a fire-separation distance of 5 feet or less.
3. [Where indicated on Drawings]<Insert requirements>.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.

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1. Use stainless steel unless otherwise indicated.
2. For pressure-preservative-treated wood, use stainless steel fasteners.
3. For redwood, use stainless steel fasteners.

B. Nails: ASTM F1667.

C. Power-Driven Fasteners: ICC-ES AC70.

D. Wood Screws and Lag Screws: ASME B18.2.1, ASME B18.6.1, or ICC-ES AC233.

E. Carbon-Steel Bolts: ASTM A307 with ASTM A563 hex nuts and, where indicated, flat washers all hot-dip zinc coated.

F. Stainless Steel Bolts: ASTM F593, Alloy Group 1 or 2; with ASTM F594, Alloy Group 1 or 2 hex nuts and, where indicated, flat washers.

G. Postinstalled Anchors: Stainless steel, torque-controlled expansion anchors with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing according to ASTM E488/E488M conducted by a qualified independent testing and inspecting agency.

1. Stainless steel bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

2.7 MISCELLANEOUS MATERIALS

A. Blocking, Shims, and Nailers: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

1. Wood-Preservative Treatment: By pressure process, AWPA U1; Use Category UC3b.

a. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
b. Preservative Chemicals: Acceptable to authorities having jurisdiction [and containing no arsenic or chromium].
c. Mark lumber with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee's (ALSC) Board of Review.

2. Fire-Retardant Treatment: Complying with requirements; provide [where indicated on Drawings]<Insert requirements>.

2.8 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate exterior architectural woodwork to dimensions, profiles, and details indicated.

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1. Ease edges to radius indicated for the following:

    a. Edges of Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.
    b. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch.

C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.

1. Disassemble components only as necessary for shipment and installation.
2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
3. Notify Architect seven days in advance of the dates and times exterior architectural woodwork fabrication will be complete.
4. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.

    a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.
    b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

2.9 SHOP PRIMING

A. Preparations for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing exterior architectural woodwork, as applicable to each unit of work.

B. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. [Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.]

C. Exterior Architectural Woodwork for Opaque Finish: Shop prime all surfaces with one coat of wood primer as specified in Section 099113 "Exterior Painting."

D. Exterior Architectural Woodwork for Transparent Finish:

1. Shop seal surfaces to be concealed
2. Shop seal exposed surfaces with stain (if specified), other required pretreatments, and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."

2.10 SHOP FINISHING

A. Finish exterior architectural woodwork [with transparent finish][indicated on Drawings] at fabrication shop. Defer only final touchup, cleaning, and polishing until after

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installation.

B. Preparation for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing exterior architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of exterior architectural woodwork. Apply two coats to end-grain surfaces.

C. Transparent Finish: Comply with Section 099300 "Staining and Transparent Finishing."

D. Opaque Finish: Comply with Section 099113 "Exterior Painting."

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition exterior architectural woodwork to average prevailing humidity conditions at Project site.

B. Before installing exterior architectural woodwork, examine shop-fabricated work for completion, and complete work as required, including removing packing and backpriming concealed surfaces.

3.2 INSTALLATION

A. Grade: Install exterior architectural woodwork to comply with same grade as item to be installed.

B. Assemble exterior architectural woodwork, and complete fabrication at Project site to the extent that it was not completed during shop fabrication.

C. Install exterior architectural woodwork level, plumb, true in line, and without distortion.

1. Shim as required with concealed shims.
2. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Standing and Running Trim:

1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.
2. Do not use pieces less than 96 inches long, except where shorter single-length pieces are necessary.
3. Scarf running joints and stagger in adjacent and related members.

E. Scribe and cut exterior architectural woodwork to fit adjoining work, refinish cut

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surfaces, and repair damaged finish at cuts.

F. Preservative-Treated Wood Materials: Where field cut or drilled, treat cut ends and drilled holes according to AWPA M4.

G. Fire-Retardant-Treated Wood Materials: Install fire-retardant-treated materials to comply with chemical treatment manufacturer's written instructions.

H. Anchor exterior architectural woodwork to anchors or blocking built in or directly attached to substrates.

1. Secure with countersunk, concealed fasteners and blind nailing.
2. Use fine finishing nails [or finishing screws] for exposed fastening, countersunk and filled flush with exterior architectural woodwork.
3. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced and with adjacent rows staggered.
4. For shop-finished items, use filler matching finish of items being installed.

I. Stair and Railing Installation:

1. Treads and Risers:

a. Install stair tread with crown side up (bark side down).
b. Secure treads and risers by gluing and nailing to carriages.

1) Extend treads over carriages [and finish with bullnose edge].

c. Countersink nail heads, fill flush, and sand filler.

2. Balusters:

a. Fit balusters to treads, glue, and nail in place.
b. Countersink nail heads, fill flush, and sand filler.
c. Let into railings and glue in place.

3. Newel Posts: Secure newel posts to stringers and risers with through bolts.
4. Railings:

a. Secure wall rails with metal brackets.
b. Fasten freestanding railings to newel posts and to trim at walls with glue and countersunk-head wood screws or rail bolts.

5. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced and with adjacent rows staggered.
6. Install stairs with no more than 3/16-inch variation between adjacent treads and risers and with no more than 3/8-inch variation between largest and smallest treads and risers within each flight.

J. Touch up finishing work specified in this Section after installation of exterior architectural woodwork.

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1. Fill nail holes with matching filler where exposed.
2. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

K. Field Finishing: See [Section 099113 "Exterior Painting"][and][Section 099300 "Staining and Transparent Finishing"] for final finishing of installed exterior architectural woodwork.

3.3 FIELD QUALITY CONTROL

A. Inspections: Provide inspection of installed Work through [AWI's Quality Certification Program][WI's Certified Compliance Program] certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.

1. Inspection entity is to prepare and submit report of inspection.

3.4 REPAIR

A. Repair damaged and defective exterior architectural woodwork, where possible, to eliminate functional and visual defects [and to result in exterior architectural woodwork being in compliance with requirements of the Architectural Woodwork Standards for the specified grade].

B. Where not possible to repair, replace defective woodwork.

3.5 CLEANING

A. Clean exterior architectural woodwork on exposed and semiexposed surfaces.

END OF SECTION 064013

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SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior standing and running trim for opaque finish.
2. Closet and utility shelving.
3. Preservative-treated wood material.
4. Miscellaneous materials.
5. Shop priming.
6. Shop finishing.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing interior architectural woodwork that are concealed within other construction before interior architectural woodwork installation.
2. Section 062023 "Interior Finish Carpentry" for interior carpentry exposed to view that is not specified in this Section.

1.2 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.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Anchors.
2. Adhesives.
3. Shop finishing materials.

B. Wood-Preservative Treatment:

1. Include data and warranty information from chemical-treatment manufacturer and

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certification by treating plant that treated materials comply with requirements.
2. Indicate type of preservative used and net amount of preservative retained.
3. Include chemical-treatment manufacturer's written instructions for finishing treated material and manufacturer's written warranty.

C. Waterborne Treatments: For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

D. Shop Drawings:

1. Include the following:

a. Dimensioned plans, elevations, and sections.
b. Attachment details.

2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.
4. Apply AWI Quality Certification Program label to Shop Drawings.

E. Samples: For each exposed product and for each shop-applied color and finish specified.

1. Size:

a. Panel Products: 12 inches by 12 inches.
b. Lumber Products: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.

F. Samples for Initial Selection: For each type of shop-applied exposed finish.

1. Size:

a. Panel Products: 12 inches by 12 inches.
b. Lumber Products: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.

G. Samples for Verification: For the following:

1. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished interior architectural woodwork.
2. Lumber and Panel Products with Shop-Applied Opaque Finish: 5 inches wide by 12 inches long for lumber and 8 by 10 inches for panels, for each finish system and color.

a. Finish one-half of exposed surface.

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1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For architectural woodwork manufacturer.

B. Product Certificates: For the following:

1. Composite wood products.
2. Adhesives.

C. Evaluation Reports: For preservative-treated wood materials, from ICC-ES.

D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

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

1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.
2. Installer Qualifications: Manufacturer of products.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Architectural Woodwork Standards, Section 2.

B. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.

C. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1. Handle and store fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions.

1.9 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of the construction period.

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B. Environmental Limitations with Humidity Control: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

C. Field Measurements: Where interior architectural woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being concealed by construction, and indicate measurements on Shop Drawings.

D. Established Dimensions: Where interior architectural woodwork 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.

PART 2 - PRODUCTS

2.1 WOODWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. Provide certificates from AWI certification program indicating that woodwork [and installation] complies with requirements of grades specified.
2. The Contract Documents contain requirements that are more stringent than the Architectural Woodwork Standards. Comply with Contract Documents and Architectural Woodwork Standards.

2.2 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

A. Architectural Woodwork Standards Grade: Economy.

1. Wood Species: Any closed-grain hardwood.
2. Wood Moisture Content: 5 to 10 percent.

2.3 CLOSET AND UTILITY SHELVING

A. Architectural Woodwork Standards Grade: Economy.

B. Shelf Material: 3/4-inch solid lumber.

C. Cleats: 3/4-inch thermally fused laminate panel.

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D. Wood Species: Any closed-grain hardwood.

E. Wood Closet Rods: 1-1/2-inch- diameter, hardwood.

F. Metal Closet Rods: 1-5/16-inch- diameter, [aluminum][chrome-plated-steel][color-coated-steel][stainless steel] tubes complying with BHMA A156.16, L03131.

G. Metal Rod Flanges: Stainless steel.

H. Wood Finish: Opaque.

2.4 HARDWOOD SHEET MATERIALS

A. Composite Wood Products: Provide materials that comply with requirements of the Architectural Woodwork Standards for each type of interior architectural woodwork and quality grade specified unless otherwise indicated.

1. Recycled Content of MDF and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert value> percent.
2. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
3. Particleboard: ANSI A208.1, Grade M-2.
4. Softwood Plywood: DOC PS 1 , medium-density overlay.
5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.5 PRESERVATIVE-TREATED-WOOD MATERIAL

A. Preservative-Treated-Wood Materials: Provide with water-repellent preservative treatment complying with AWPA N1 (dip, spray, flood, or vacuum-pressure treatment).

1. Preservative Chemicals: 3-iodo-2-propynyl butyl carbamate (IPBC) [, combined with a compatible EPA-registered insecticide].
2. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.

B. Extent of Preservative-Treated Wood Materials: Treat interior architectural woodwork in contact with concrete or masonry.

2.6 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Nailers: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

1. Preservative Treatment: Provide softwood lumber treated by pressure process, AWPA U1; Use Category UC3b.

a. Provide where in contact with concrete or masonry.

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b. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
c. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
d. Mark lumber with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee's (ALSC) Board of Review.

B. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.

C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.

1. Provide metal expansion sleeves or expansion bolts for post-installed anchors.
2. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

D. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

2.7 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated.

1. Ease edges to radius indicated for the following:

a. Edges of Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.
b. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch.

C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.

1. Disassemble components only as necessary for shipment and installation.
2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
3. Notify Architect seven days in advance of the dates and times interior architectural woodwork fabrication will be complete.
4. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.

a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.
b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

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D. Stairs: Cut rough carriages to accurately fit treads and risers.

1. Glue treads to risers, and glue and nail treads and risers to carriages.
2. House face stringers, and glue and wedge treads and risers.
3. Fabricate stairs with treads and risers no more than 1/8 inch from indicated position and no more than 1/16 inch out of relative position for adjacent treads and risers.

2.8 SHOP PRIMING

A. Preparations for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.

B. Interior Architectural Woodwork for Opaque Finish: Shop prime with one coat of wood primer as specified in Section 099123 "Interior Painting."

1. Backpriming: Apply one coat of primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

C. Interior Architectural Woodwork for Transparent Finish: Shop-seal concealed surfaces with required pretreatments and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."

1. Backpriming: Apply one coat of sealer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

2.9 SHOP FINISHING

A. Finish interior architectural woodwork indicated on Drawings at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.

B. Preparation for Finishing: Comply with Architectural Woodwork Standards, Section 5 for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of interior architectural woodwork. Apply two coats to end-grain surfaces.

C. Transparent Finish:

1. Architectural Woodwork Standards Grade: Custom.
2. Finish System:

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a. 1: Lacquer, Nitrocellulose.
b. 2: Lacquer, Pre Catalyzed.
c. 3: Lacquer, Post Catalyzed.
d. 4: Latex Acrylic, Water Based.
e. 5: Varnish, Conversion.
f. 6: Oil, Synthetic Penetrating.
g. 7: Vinyl, Catalyzed.
h. 8: Acrylic Cross Linking, Water Based.
i. 9: UV Curable, Acrylated Epoxy, Polyester, or Urethane.
j. 10: UV Curable, Water Based.
k. 11: Polyurethane, Catalyzed.
l. 12: Polyurethane, Water Based.
m. 13: Polyester, Catalyzed.

3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
4. Staining: Match Architect's sample.
5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
6. Filled Finish for Open-Grain Woods: After staining, apply wash-coat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
7. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter in accordance with ASTM D523.

D. Opaque Finish:

1. Architectural Woodworking Standards Grade: Custom.
2. Finish System:

a. 1: Lacquer, Nitrocellulose.
b. 2: Lacquer, Pre Catalyzed.
c. 3: Lacquer, Post Catalyzed.
d. 4: Latex Acrylic, Water Based.
e. 5: Varnish, Conversion.
f. 7: Vinyl, Catalyzed.
g. 8: Acrylic Cross Linking, Water Based.
h. 9: UV Curable, Acrylated Epoxy, Polyester, or Urethane.
i. 10: UV Curable, Water Based.
j. 11: Polyurethane, Catalyzed.
k. 12: Polyurethane, Water Based.
l. 13: Polyester, Catalyzed.

3. Color: As selected by Architect from manufacturer's full range.
4. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter in accordance with ASTM D523.

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PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.

B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of concealed surfaces.

3.2 INSTALLATION

A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.

B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.

C. Install interior architectural woodwork level, plumb, true in line, and without distortion.

1. Shim as required with concealed shims.
2. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Preservative-Treated Wood: Where cut or drilled in field, treat cut ends and drilled holes in accordance with AWPA M4.

F. Fire-Retardant-Treated Wood: Install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

G. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates.

1. Secure with countersunk, concealed fasteners and blind nailing.
2. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with interior architectural woodwork.
3. For shop-finished items, use filler matching finish of items being installed.

H. Standing and Running Trim:

1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.
2. Do not use pieces less than 60 inches long, except where shorter single-length pieces are necessary.
3. Scarf running joints and stagger in adjacent and related members.

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4. Fill gaps, if any, between top of base and wall with plastic wood filler; sand smooth; and finish same as wood base if finished.
5. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.

I. Stairs: Securely anchor carriages to supporting substrates.

1. Install stairs with treads and risers no more than 1/8 inch from indicated position.
2. Secure with countersunk, concealed fasteners and blind nailing.
3. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with wood surface.

J. Railings:

1. Install rails with no more than 1/8 inch in 96-inch variation from a straight line.
2. Stair Rails: Glue and dowel or pin balusters to treads and railings, and railings to newel posts.

    a. Secure with countersunk, concealed fasteners and blind nailing.
    b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with wood surface.

3. Wall Rails: Support rails on wall brackets securely fastened to wall framing.

    a. Space rail brackets not more than 48 o.c.

3.3 FIELD QUALITY CONTROL

A. Inspections: Provide inspection of installed Work through certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.

1. Inspection entity is to prepare and submit report of inspection.

3.4 REPAIR

A. Repair damaged and defective interior architectural woodwork, where possible, to eliminate functional and visual defects and to result in interior architectural woodwork being in compliance with requirements of Architectural Woodwork Standards for the specified grade.

B. Where not possible to repair, replace defective woodwork.

C. Shop Finish: Touch up finishing work specified in this Section after installation of interior architectural woodwork.

1. Fill nail holes with matching filler where exposed.
2. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

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D. Field Finish: See Section 099123 "Interior Painting" for final finishing of installed interior architectural woodwork not indicated to be shop finished.

3.5 CLEANING

A. Clean interior architectural woodwork on exposed and semiexposed surfaces.

END OF SECTION 064023

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SECTION 064100 - ARCHITECTURAL WOOD CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood-veneer-faced casework for transparent finish.
2. Wood-veneer-faced casework for opaque finish.
3. Plastic-laminate-clad casework.
4. Wood materials.
5. Glass.
6. Casework hardware.
7. Accessories.
8. Shop finishing.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.
2. Section 092216 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud-framing required for anchoring cabinets.
3. [Section 123616 "Metal Countertops."][Section 123619 "Wood Countertops."][Section 123623.13 "Plastic-Laminate-Clad Countertops."][Section 123640 "Stone Countertops."][Section 123661 "Simulated Stone Countertops."]

1.2 ALLOWANCES

A. See Section 012100 "Allowances" for description of allowances affecting items specified in this Section.

B. Wood Veneer Allowance: Wood veneer for architectural cabinets is part of [Wood Veneer Allowance]<Insert name of allowance>. Allowance includes the cost of veneer that is wasted due to selection, cutting, and trimming.

1.3 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

B. Coordinate wood species, veneer, cut, grade, matching, finishing, and other requirements with [wood doors][wood paneling]<Insert item> as specified in [Section 064216 "Flush Wood Paneling."][Section 081416 "Flush Wood Doors."][Section

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123553.19 "Wood Laboratory Casework."]<Insert Section number and title.>

C. Hardware Coordination: Distribute copies of approved hardware schedule specified in [Section 087100 "Door Hardware"][Section 087111 "Door Hardware (Descriptive Specification)"] to manufacturer of architectural cabinets; coordinate Shop Drawings and fabrication with hardware requirements.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review locations and method of attachment of backing required for casework installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include panel material description and finish.
2. Include glazing.
3. Include accessories.
4. Include hardware.
5. Include shop finishing.

B. Shop Drawings:

1. Plans, elevations, sections, and attachment details.

a. Show large-scale details.
b. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
c. Show locations and sizes of cutouts and holes for items installed in architectural cabinets.
d. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

2. Apply AWI's Quality Certification Program (hereafter AWI QCP) label to Shop Drawings.

C. Samples for Initial Selection: For each exposed product and for each color and finish specified, in manufacturer's standard size.

D. Samples for Verification: Provide a minimum of three samples showing the full range of color and/or grain to be expected in the finished work, for the following.

1. Lumber for Transparent Finish: Not less than 8 inches long by 3/4 inch thick, and as wide as practical, for each species and cut, finished on one side and one edge.

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2. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished cabinets. Samples to show the full range of color and grain to be expected.
3. Veneer Panel for Transparent Finish: 8 by 8 inches by 1/4 inch, representative of and selected from flitches to be used for transparent-finished casework.
4. Lumber and Panel Products with Shop-Applied Opaque Finish: Not less than 8 inches long by 3/4 inches thick, and as wide as practical, for each species and cut for lumber and 8 by 10 inches for panels, for each finish system and color.

    a. Finish [entire][one-half of] exposed surface.

5. Plastic Laminates: 8 by 8 inches, for each type, color, pattern, and surface finish required.

    a. Provide one Sample applied to core material with specified edge material applied to one edge.

6. Thermally Fused Laminate (TFL) Panels: 8 by 10 inches, for each color, pattern, and surface finish.

    a. Provide edgebanding on one edge.

7. Corner Pieces:

    a. Cabinet-front frame joints between stiles and rails and at exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
    b. Miter joints for standing trim.

8. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.6 INFORMATIONAL SUBMITTALS

A. Test Reports: Valid AWI "Performance Quality Test Report" indicating compliance with specified ANSI/AWI 0641 Structural Performance Duty Level.

B. Certification Reports:

1. Provide [labels][and][certificates] from AWI QCP indicating woodwork [complies][and installation comply] with requirements of aesthetic grade and duty level specified.

    a. Project has been registered with AWI as AWI QCP Number <Insert number>.
    b. Register the Work of this Section with AWI's Quality Certification Program.

C. Product Certificates: For [each type of product.][the following:]

1. Composite wood products.
2. Thermally fused laminate (TFL) panels.

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3. Glass.
4. Adhesives.

D. Field quality control reports.

E. Qualification Statements: For [manufacturer][and][Installer].

1.7 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: AWI QCP Certificate.

1.8 QUALITY ASSURANCE

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

1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

B. Installer Qualifications: [Manufacturer of products][Licensed participant in AWI QCP].

1.9 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups of [typical architectural cabinets as indicated on Drawings]<Insert description>.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.11 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and

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maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Environmental Limitations with Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between [25 and 45][30 and 55][43 and 65]<Insert numbers> percent during the remainder of the construction period.

C. Field Measurements: Where cabinets are 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 cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

D. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

1. <Insert, in separate subparagraphs, names of preapproved woodworking firms>.

2.2 PERFORMANCE REQUIREMENTS

A. Unless otherwise indicated, comply with ANSI/AWI 0641 for duty level and grade of architectural cabinets indicated for construction, finishes, installation, and other requirements.

1. Provide [labels][and][certificates] from AWI QCP indicating that woodwork [complies][and installation comply] with requirements of aesthetic grade and duty level specified.
2. The Contract Documents contain requirements that are more stringent than the referenced woodwork quality standard. Comply with requirements of the Contract Documents in addition to those of the referenced quality standard.

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2.3 PLASTIC-LAMINATE-CLAD CASEWORK

A. Architectural Woodwork Institute (AWI) Standard:

1. Structural Performance Duty Level: 1.
2. Aesthetic Performance Grade: Premium.
3. Product Data: Verify materials were fabricated within 100 miles of Project site from materials that have been extracted, harvested, or recovered within 100 miles of Project site.
4. Product Data: Verify materials were fabricated within 500 miles of Project site from materials that have been extracted, harvested, or recovered within 500 miles of Project site. If materials are transported by rail or water, multiply the distance by 0.25 to determine the distance to Project site.
5. Certified Wood: Verify wood products are certified as "FSC Pure" [or "FSC Mixed Credit"] in accordance with FSC STD-01-001 and FSC STD-40-004.
6. Certified Wood: Verify wood products are labeled in accordance with the AF&PA's Sustainable Forestry Initiative, certified as "FSC Pure" in accordance with FSC STD-01-001 and FSC STD-40-004, or certified and labeled in accordance with the standards of the Programme for Endorsement of Forest Certification.
7. Certified Wood: Verify wood products are certified in accordance with the American Tree Farm System's "ATFS 2021 Standards of Sustainability," the AF&PA's Sustainable Forestry Initiative, FSC STD-01-001 and FSC STD-40-004, or the standards of the Programme for Endorsement of Forest Certification.
8. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in CARB 93120, "Airborne Toxic Control Measure (ATCM) for Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.
9. Composite Wood Products: Verify formaldehyde emission rates are not greater than the following when tested in accordance with ASTM D6007 or ASTM E1333:

    a. Hardwood Plywood: 0.05 ppm.
    b. Particleboard: 0.09 ppm.
    c. MDF More Than 5/16 Inch (8 mm) Thick: 0.11 ppm.
    d. MDF 5/16 Inch (8 mm) or Less in Thickness: 0.13 ppm.

10. Verify adhesives have a VOC content of 30 g/L or less.

B. Casework Construction Type: Frameless.

C. Door and Drawer-Front:

1. Design: Flush panel.
2. Style: Flush overlay.

    a. Reveal Dimension: As determined by hinge type and clearance.

D. High-Pressure Decorative Laminate (HDPL): ISO 4586-3, grades as indicated or, if not indicated, as required by quality standard.

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

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following:

a. Formica Corporation
b. Laminart LLC
c. Wilsonart LLC

E. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated by laminate manufacturer's designations.
2. Match Architect's sample.
3. As selected by Architect from laminate manufacturer's full range in the following categories:

a. Solid colors, matte finish.
b. Solid colors with core same color as surface, matte finish.
c. Wood grains, matte finish.
d. Patterns, matte finish.

F. Exposed Exterior Surfaces:

1. Plastic-Laminate Grade: HGP.
2. Pattern Direction: As indicated on Drawings.
3. Edgebanding: PVC, 3.0 mm thick.

G. Exposed Interior Surfaces: Thermally fused laminate (TFL) the same color and pattern as exterior surfaces.

1. Edgebanding: PVC, 3.0 mm thick.

H. Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Thermally fused laminate (TFL) panels.
2. Drawer Sides and Backs: Thermally fused laminate (TFL) panels with PVC or polyester edgebanding.
3. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate (HDPL), ISO 4583-3, grade to match exposed surface.
4. Drawer Bottoms: Hardwood plywood.
5. Shelves: Adjustable.

a. Loading Capacity: 50 lb/sq. ft.

6. Edgebanding: PVC, 3.0 mm thick.

2.4 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

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1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches wide.
2. Wood Moisture Content:

    a. Non-Climate-Controlled Environments: 9 to 15 percent.
    b. Climate-Controlled Environments: 6 to 10 percent.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent.
2. Medium-Density Fiberboard (MDF): ANSI A208.2, [Grade 130]<Insert grade>.
3. Particleboard (Medium Density): ANSI A208.1, Grade M-2-Exterior Glue.
4. Softwood Plywood: DOC PS 1 [, medium-density overlay].
5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.
6. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper [and complying with requirements of AWI 300].

2.5 GLASS

A. Float Glass for Cabinet Doors: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

1. Thickness: 4.0 mm.
2. Tint Color: [Blue-green][Bronze][Green][Gray]<Insert color>.

B. Tempered Float Glass for Cabinet Doors: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), complying with ANSI Z97.1.

1. Door Inserts: Type I, Class 1 (clear), Quality-Q3.

    a. Thickness: 6.0 mm.
    b. Tint Color: [Blue-green][Bronze][Green][Gray]<Insert color>.

2. Frameless Sliding Doors: Type I, Class 1 (clear), Quality-Q3.

    a. Thickness: 6.0 mm.
    b. Tint Color: [Blue-green][Bronze][Green][Gray]<Insert color>.
    c. Unframed Glass Doors: Grind smooth and polish exposed edges and corners.

C. Laminated Glass for Cabinet Doors: ASTM C1172, Type II, complying with ANSI Z97.1.

1. Thickness: [6.0 mm]<Insert thickness>.
2. Tint Color: [Blue-green][Bronze][Green][Gray]<Insert color>.

D. Mirror Glass for Cabinet Doors: ASTM C1503, Mirror Select, Quality-Q3.

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1. Thickness: 4.0 mm.

E. Decorative Glass for Cabinet Doors: Provide decorative glass complying with Section 088113 "Decorative Glass Glazing."

F. Tempered Float Glass for Cabinet Shelves: ASTM C1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3; with exposed edges seamed before tempering, 6 mm thick.

1. Thickness: 4.0 mm.
2. Tint Color: [Blue-green][Bronze][Green][Gray]<Insert color>.

2.6 CASEWORK HARDWARE

A. Cabinet Hardware: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in [Section 087100 "Door Hardware."][Section 087111 "Door Hardware (Descriptive Specification)."]

B. Hinges:

1. Butt Hinges: 2-3/4-inch, Grade 1 five-knuckle steel hinges made from 0.095-inch-thick metal, and as follows:

a. Semi-Concealed Hinges, Back Mounted, for Flush Doors: ANSI/BHMA A156.9, B01361.
b. Semi-Concealed Hinges, Back Mounted, for Overlay Doors: ANSI/BHMA A156.9, B01511.

2. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, [95-110][115-140][160-180] degrees of opening , with integral soft-close damper.

C. Pulls and Knobs:

1. Back-Mounted Pulls: ANSI/BHMA A156.9, B02011, 3-inch centers.
2. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.
3. Back-Mounted Knobs: ANSI/BHMA A156.9, B02041.

D. Catches and Latches:

1. Magnetic Catches: ANSI/BHMA A156.9, B03141.
2. Push-in Magnetic Catches: ANSI/BHMA A156.9, B03132.
3. Roller Catches, Double Rollers: ANSI/BHMA A156.9, B03072.
4. Ball Friction Catches: ANSI/BHMA A156.9, B03013.

E. Shelf Rests and Standards:

1. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04102; with shelf brackets, B04112.
2. Shelf Rests: ANSI/BHMA A156.9, B04013; metal.

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F. Drawer Slides: ANSI/BHMA A156.9.

1. Standard Duty (Grade 1 and Grade 2): Undermount.
2. Heavy-Duty (Grade 1HD and Grade 1HD-200): Undermount.

a. Type: Full extension.
b. Material: Zinc-plated ball-bearing slides.
c. Motion Feature: soft close dampener.

3. Drawer Types:

a. Pencil drawers not more than 3 inches high and not more than 24 inches wide provide [50 lb]<Insert weight> load capacity.
b. General-purpose drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide [75 lb]<Insert weight> load capacity.
c. File drawers more than 6 inches high or more than 24 inches wide provide [100 lb]<Insert weight> load capacity.
d. Lateral file drawers more than 6 inches high and more than 24 inches, but not more than 30 inches wide, provide [150 lb]<Insert weight> load capacity.
e. Lateral file drawers more than 6 inches high and more than 30 inches wide provide [200 lb]<Insert weight> load capacity.
f. Computer keyboard tray provides [75 lb]<Insert weight> load capacity.

G. Tracks for Sliding Glass Doors: Recessed mounting, ANSI/BHMA A156.9, B07063; aluminum.

H. Locks for Drawer and Hinged-Doors: Cylindrical (cam) type, five-pin tumbler, brass with chrome-plated finish, and complying with ANSI/BHMA A156.11, Grade 1.

1. Provide a minimum of two keys per lock and six master keys.
2. Provide locks where indicated.

I. Door Bumpers: Manufacturer's standard self-adhering clear silicone pads.

J. Hardware Finish:

1. Exposed Hardware: Provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.

a. Dark, Oxidized, Satin Bronze, Oil Rubbed: ANSI/BHMA 613 for bronze base; ANSI/BHMA 640 for steel base.
b. Bright Brass, Clear Coated: ANSI/BHMA 605 for brass base; ANSI/BHMA 632 for steel base.
c. Bright Brass, Vacuum Coated: ANSI/BHMA 723 for brass base; ANSI/BHMA 729 for zinc-coated-steel base.
d. Satin Brass, Blackened, Bright Relieved, Clear Coated: ANSI/BHMA 610 for brass base; ANSI/BHMA 636 for steel base.
e. Satin Chromium Plated: ANSI/BHMA 626 for brass or bronze base; ANSI/BHMA 652 for steel base.

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f. Bright Chromium Plated: ANSI/BHMA 625 for brass or bronze base; ANSI/BHMA 651 for steel base.
g. Satin Stainless Steel: ANSI/BHMA 630.

2. Concealed Hardware: Manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.7 ACCESSORIES

A. Grommets:

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

a. [Doug Mockett & Company, Inc.]
b. [Hafele America Co.]
c. [W.W. Grainger, Inc.]
d. <Insert manufacturer's name>

2. Wire-Management Grommets: Circular, grommets and matching caps with slot for wire passage.

a. Finish: Molded plastic.
b. Outside Diameter: 2 inches.
c. Color: Black.

3. Power/Data Grommets: UL-listed recessed grommet.

a. Power Outlets: Two.
b. USB Charger: 1 Dual.

4. Paper Slot Grommet: 17 inches long by 1-3/4 inches wide by 1 inch deep; molded-plastic, paper-slot liner with 1/4 inch lip.

a. Color: Black.

2.8 FABRICATION

A. Fabricate architectural cabinets to dimensions, profiles, and details indicated. Ease sharp edges and corners.

B. 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. Notify Architect seven days in advance of dates and times architectural cabinet fabrication will be complete.
2. Trial fit assemblies at manufacturer's shop that cannot be shipped completely

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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 before disassembling for shipment.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

D. Install glass to comply with applicable requirements in Section 088000 "Glazing" and in NGA's "GANA Glazing Manual."

1. For glass in wood frames, secure glass with removable stops.
2. For exposed glass edges, polish and grind smooth.

2.9 SHOP FINISHING

A. Finish architectural cabinets at manufacturer's shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Shop-finish transparent-finished architectural cabinets at manufacturer's shop as specified in this Section. See Section 099123 "Interior Painting" for field finishing of opaque-finished architectural cabinets.

C. Drawings indicate items that are required to be shop finished. Finish these items at manufacturer's shop as specified in this Section. See [Section 099123 "Interior Painting"][and][Section 099300 "Staining and Transparent Finishing"] for field finishing of architectural cabinets.

D. Shop Priming: Shop apply the prime coat including backpriming, if any, for [transparent-finished] items specified to be field finished. See [Section 099123 "Interior Painting"][and][Section 099300 "Staining and Transparent Finishing"] for material and application requirements.

E. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural cabinets, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of cabinets.

F. Transparent Finish:

1. Aesthetic Performance Grade: [Premium][Custom][Economy][Same as item to be finished].
2. Finish System: [TR-1, lacquer, nitrocellulose][TR-2A, lacquer, post-catalyzed][TR-2B, lacquer, pre-catalyzed][TR-3, latex acrylic, water-based][TR-4, varnish, conversion][TR-5, oil, synthetic penetrating][TR-6, polyurethane, catalyzed][TR-7, acrylic crosslinking, water-based][TR-8, acrylated epoxy,

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polyester, or urethane, UV-cure][TR-9, UV curable, water-based][TR-10, vinyl, catalyzed][TR-11, polyurethane, water-based][TR-12, polyester, catalyzed].

3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to cabinets made from closed-grain wood before staining and finishing.
4. Staining: [None required][Match approved sample for color][Match Architect's sample].
5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
6. Filled Finish for Open-Grain Woods: [After staining, apply wash-coat sealer and allow to dry.] Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
7. Sheen: [Flat, 15-30][Satin, 31-45][Semigloss, 46-60][Gloss, 61-100] gloss units measured on 60-degree gloss meter per ASTM D523.

G. Opaque Finish:

1. Aesthetic Performance Grade: [Premium][Custom][Economy][Same as item to be finished].
2. Finish System: [OP-1, lacquer, nitrocellulose][OP-2A, lacquer, post-catalyzed][OP-2B, lacquer, pre-catalyzed][OP-3, latex acrylic, water-based][OP-4, varnish, conversion][OP-5, oil, synthetic penetrating][OP-6, polyurethane, catalyzed][OP-7, acrylic crosslinking, water-based][OP-8, acrylated epoxy, polyester, or urethane, UV-cure][OP-9, UV curable, water-based][OP-10, vinyl, catalyzed][OP-11, polyurethane, water-based][OP-12, polyester, catalyzed].
3. Color: [As indicated by manufacturer's designations][Match Architect's sample][As selected by Architect from manufacturer's full range].
4. Sheen: [Flat, 15-30][Satin, 31-45][Semigloss, 46-60][Gloss, 61-100] gloss units measured on 60-degree gloss meter per ASTM D523.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of the Work.

1. Confirm location and adequacy of blocking and supports required for installation.
2. Verify size and locations of cutouts for appliances, special equipment, sinks, plumbing, and other items to be mounted in or adjacent to casework.

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

3.2 PREPARATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

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3.3 INSTALLATION OF CASEWORK

A. Install casework to comply with requirements of the structural and aesthetic performance specified.

B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

C. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
3. Maintain veneer sequence matching of cabinets with transparent finish.

D. Anchor cabinets in accordance with AWI requirements or tested method to anchors or blocking built in or directly attached to framing or substrates.

1. Install cabinets to comply with seismic requirements as indicated on Drawings.

E. Shop Finishes: Touch up finishing after installation of architectural cabinets. Fill nail holes with matching filler.

1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

a. Use filler matching finish of items being installed.

F. Field Finishing: See [Section 099123 "Interior Painting"][and][Section 099300 "Staining and Transparent Finishing"] for finishing of installed architectural cabinets.

3.4 FIELD QUALITY CONTROL

A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program certifying that casework, including installation, complies with requirements of ANSI/AWI 0620 for the specified grade.

1. AWI QCP Inspector to prepare and submit inspection report.

3.5 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where impossible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.

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B. Clean, lubricate, and adjust hardware and other moving parts to function smoothly.

C. Clean cabinets on exposed and semiexposed surfaces. Touch up finishes to restore damaged or soiled areas.

END OF SECTION 064100

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SECTION 071353 - ELASTOMERIC SHEET WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Accessory waterproofing system materials.
2. Protection course.
3. Electronic leak-detection (ELD) materials.

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for forms and waterstops.
2. Section 072100 "Thermal Insulation" for below-grade foundation insulation.
3. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
4. Section 079513.16 "Exterior Expansion Joint Cover Assemblies" for exterior-wall expansion-joint assemblies that interface with waterproofing.
5. Section 079513.19 "Parking Deck Expansion Joint Cover Assemblies" for deck expansion-joint assemblies that interface with waterproofing.

1.2 COORDINATION

A. Coordinate Work under this Section with adjacent concrete foundation work, including fill [, other waterproofing systems][, under-slab vapor retarders][, under-slab insulation][and][, subdrainage systems].

B. Coordinate requirements for concrete formwork to provide suitable substrate for waterproofing and to minimize penetrations through waterproofing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference [at Project site][by web conference]<Insert location>.

1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.
2. Review transitions within waterproofing system and between waterproofing and adjacent air barrier.

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1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

B. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, expansion joints, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

C. Samples: For the following products:

1. 8-by-8-inch square of waterproofing and flashing sheet.
2. 4-by-4-inch square of drainage panel.
3. Plaza-deck paver, [4-by-4-inch square][full sized], in each color and texture required.
4. Paver pedestal assembly.

D. Sustainable Design Submittals:

1. Product Data: For waterproofing, providing information for testing in compliance with CCR, Title 24, Part 2, Section 1202 and Ch. 14.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For Installer.

B. Field quality control reports.

C. Sample warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Entity that employs installers and supervisors who are trained and [certified][approved] by waterproofing manufacturer.

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to set quality standards for installation.

1. Build for each typical waterproofing installation including [pavers and]

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accessories to demonstrate surface preparation, crack and joint treatments, inside and outside corner treatments, and protection.

a. Size: [100 sq. ft. in area][As indicated on Drawings].
b. Description: Each type of [wall][deck][and][plaza]<Insert description> installation.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty Period: [10][20]<Insert number> years from date of Substantial Completion.

B. Installer's Special Warranty: Specified form, [on warranty form at end of this Section,] signed by Installer, covering Work of this Section, for warranty period of [two]<Insert number> years.

1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, [and][plaza-deck pavers][, including paver pedestal assembly].

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Waterproofing System: Obtain waterproofing materials [and][protection course][drainage panels] from [same manufacturer as waterproofing membrane][or][manufacturer approved by waterproofing membrane manufacturer].

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B. Plaza-Deck Paving: Obtain plaza-deck pavers [and paver pedestals] from single source from single manufacturer.

2.2 ACCESSORY WATERPROOFING SYSTEM MATERIALS

A. General: Accessory materials as recommended in writing by waterproofing manufacturer for intended use and compatibility with one another and with sheet waterproofing.

1. Furnish liquid-type accessory materials that comply with VOC limits of authorities having jurisdiction.

B. Concealed Sheet Flashing: Same material, construction, and thickness as sheet waterproofing or 60-mil- thick, uncured EPDM, as required by manufacturer.

C. Exposed Sheet Flashing: 60-mil- thick EPDM, cured or uncured, as required by manufacturer.

D. Bonding Adhesives: For bonding waterproofing sheets and sheet flashings to substrates and projections.

E. Splicing Cement and Cleaner: Single-component butyl splicing cement and solvent-based splice cleaner.

1. Butyl Gum Tape: 30-mil- thick by 6-1/4-inch- wide, uncured butyl with polyethylene release film.

F. Lap Sealant: Single-component sealant.

G. In-Seam Sealant: Single-component sealant.

H. Water-Cutoff Mastic: Butyl mastic sealant.

I. Waterproofing and Sheet-Flashing Accessories: Sealants, pourable sealers, cone and vent flashings, inside and outside corner flashings, termination reglets, and other accessories recommended by waterproofing manufacturer for intended use.

J. Metal Termination Bars: Manufacturer's standard aluminum bars, approximately 1 inch wide, prepunched, with fasteners.

2.3 PROTECTION COURSE

A. Protection course material of type and thickness as recommended in writing by waterproofing manufacturer for each Project condition.

2.4 ELECTRONIC LEAK-DETECTION (ELD) MATERIALS

A. Conductive Medium: Electrically conductive material specifically designed to enable

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ELD testing procedures as approved in writing by waterproofing membrane manufacturer.

1. Conductive medium to be located directly under waterproofing membrane in accordance with ASTM D7877 and ASTM D8231.

B. Moisture-Monitoring System: Permanently embedded, continuously monitored moisture-detection system.

1. Sensors measuring moisture content to be placed within waterproofing system and connected to a monitoring program, with a notification indicating location of breach.

2.5 PLAZA-DECK PAVERS

A. Plaza-Deck Pavers: [Brick][Concrete][Asphalt-block] pavers specified in Section 321400 "Unit Paving."

B. Stone Plaza-Deck Pavers: [Granite][Limestone][Marble][Quartz-based stone][Slate][Travertine]<Insert type> pavers specified in Section 321400 "Unit Paving."

C. Plaza-Deck Paver Metal Straps: Securement strapping fabricated from stainless steel, a minimum of 3 inches wide by 0.031 inch thick with stainless steel anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate preparations and other conditions affecting performance of waterproofing.

1. Verify that concrete substrate has cured and aged for minimum time recommended in writing by waterproofing manufacturer.
2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by waterproofing manufacturer. Test for capillary moisture by plastic sheet method in accordance with ASTM D4263.

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

3.2 PREPARATION

A. Clean, prepare, and treat substrates in accordance with manufacturer's written installation instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

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B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.

E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks in accordance with ASTM D4258.

F. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions.

3.3 INSTALLATION OF ELECTRONIC LEAK-DETECTION (ELD) MATERIALS

A. Install conductive medium directly under waterproofing membrane in accordance with ASTM D7877 and ASTM D8231.

B. Install sensors, connections, and accessory items required for complete continuously monitored moisture-detection system in accordance with waterproofing manufacturer's written installation instructions.

3.4 INSTALLATION OF PROTECTION COURSE

A. Install protection course over waterproofing membrane in accordance with manufacturer's written instructions and before beginning subsequent construction operations. Minimize exposure of membrane.

1. Molded-sheet drainage panels may be used in place of a separate protection course for vertical applications when approved by waterproofing manufacturer.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: [Owner will engage][Engage] a qualified testing agency to perform tests.

B. Perform the following tests before overlying construction is placed:

1. ELD Testing: Testing agency surveys entire horizontal waterproofed area and flashings to locate discontinuities in the system assembly using ELD in accordance with ASTM D7877 and ASTM D8231.

a. After testing, repair areas of discontinuities, repeat tests, and make further repairs until waterproofing and flashing installations are contiguous.

1) Cost of retesting is Contractor's responsibility.

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b. Testing agency to prepare survey report indicating locations of initial discontinuities, if any.

2. Flood Testing: Flood test each completed horizontal waterproofed area for leaks, in accordance with recommendations in ASTM D5957. Install temporary containment assemblies, plug, or dam drains, and flood with potable water.

a. Flood to an average depth of [2-1/2 inches]<Insert depth> with a minimum depth of [1 inch]<Insert depth> and not exceeding a depth of [4 inches]<Insert depth>. Maintain 2 inches of clearance from top of base flashing.
b. Flood each area for [24][48][72] hours.
c. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing and flashing installations are watertight.

1) Cost of retesting is the responsibility of Contractor.

d. Testing agency to prepare survey report indicating locations of initial leaks, if any, and final survey report.

C. Manufacturer's Field Service: Engage a [full-time] site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components; and to furnish daily reports to Architect.

1. Final Inspection: Arrange for waterproofing system manufacturer's technical personnel to inspect system installation on completion, in presence of Architect, and to prepare inspection report.
2. Notify Architect [and Owner] 48 hours in advance of date and time of inspection.
3. Repair or remove and replace components of waterproofing system where inspections indicate that they do not comply with specified requirements.

D. Additional Tests and Inspections:

1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.
2. Waterproofing system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 PROTECTION, REPAIR, AND CLEANING

A. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Protect installed waterproofing from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent

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construction immediately after installation.

D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

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SECTION 071416 - COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cold-applied rubberized asphalt waterproofing.
2. Latex waterproofing.
3. Accessory waterproofing system materials.
4. Protection course.
5. Molded-sheet drainage panels.
6. Electronic leak-detection (ELD) materials.

B. Related Requirements:

1. Section 071800 "Traffic Coatings" for exposed, fluid-applied membrane with an integral wearing surface.
2. Section 072100 "Thermal Insulation" for below-grade foundation insulation.
3. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
4. Section 079513.16 "Exterior Expansion Joint Cover Assemblies" for exterior expansion-joint assemblies that interface with waterproofing.
5. Section 079513.19 "Parking Deck Expansion Joint Cover Assemblies" for deck expansion-joint assemblies that interface with waterproofing.
6. Section 334600 "Subdrainage" for molded-sheet drainage panels.

1.2 DEFINITIONS

A. Compatible: Material that will not adversely affect adjacent materials, is chemically compatible with adjacent materials, and where required for bond, achieves adhesive compatibility with adjacent materials.

B. Chemical Compatibility: Material that will not break down, deteriorate, degrade, or prematurely fail when in contact with another material. Material that will not cause chemical breakdown, deterioration, degradation, staining, or premature failure of another material.

C. Adhesive Compatibility: Material that will develop bond strength or provide a suitable surface for another material to develop bond strength complying with requirements when in contact with another material.

1.3 COORDINATION

A. Coordinate Work under this Section with adjacent concrete foundation work, including

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fill [, other waterproofing systems][, under-slab vapor retarders][, under-slab insulation][and][, subdrainage systems].

B. Coordinate requirements for concrete formwork to provide suitable substrate for waterproofing and to minimize penetrations in waterproofing.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]<Insert location>.

1. Review waterproofing requirements, including, but not limited to, the following:

a. Surface preparation specified in other Sections.
b. Minimum concrete curing period.
c. Forecasted weather conditions.
d. Special details and sheet flashings.
e. Repairs.
f. Field quality control.
g. <Insert agenda items>.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

B. Shop Drawings:

1. Indicate locations and extent of waterproofing.
2. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, expansion-joint conditions, tie-ins with adjoining waterproofing, and other termination conditions.
3. Include setting drawings indicating layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

C. Samples: For the following materials:

1. Cured sample of waterproofing membrane on suitable rigid substrate, 8 by 8 inches.
2. Flashing sheet, 8 by 8 inches.
3. Membrane-reinforcing fabric, 8 by 8 inches.
4. Drainage panel, 4 by 4 inches.
5. Plaza-deck paver, [4 by 4 inches][full sized].
6. Paver pedestal assembly.

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1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For [Installer][and][testing agency].

B. Field quality control reports.

C. Sample warranties.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Entity that employs installers and supervisors who are trained and [certified][approved] by waterproofing manufacturer.

1.8 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to set quality standards for installation.

1. Build mockup for each typical waterproofing installation, including [pavers and] accessories to demonstrate surface preparation, crack and joint treatments, inside and outside corner treatments, and protection.

a. Size: [100 sq. ft. in area][As indicated on Drawings].
b. Description: Each type of [wall][deck][and][plaza deck]<Insert description> installation.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer. Protect stored materials in accordance with manufacturer's written instructions.

B. Remove and replace materials that cannot be applied within their stated shelf life.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer.

1. Do not apply waterproofing to frozen, damp, or wet substrates, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F above

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dew point.

2. Do not apply waterproofing when snow, rain, fog, or mist are present, or when such weather conditions are imminent during application and curing period.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.11 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or remove and replace waterproofing that fails to remain watertight within specified warranty period.

1. Warranty includes leak remediation, including repair, removal, and replacement of [protection course][drainage panels][and][pedestals and pavers on plaza decks].
2. Pavers Warranty: Pavers must not dish or warp, nor crack, split, or disintegrate in freeze-thaw conditions.
3. Warranty Period: [Five][10]<Insert number> years from date of Substantial Completion.

B. Installer's Special Warranty: Submit warranty [, on warranty form at end of this Section,] signed by Installer, covering the Work of this Section, for warranty period of [two]<Insert number> years from date of Substantial Completion.

1. Warranty includes leak remediation, including repair, removal, and replacement of [protection course][drainage panels][and][pedestals and pavers on plaza decks].

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Waterproofing System: Obtain waterproofing materials [and][protection course][molded-sheet drainage panels][insulation drainage panels] from [same manufacturer as waterproofing membrane][or][manufacturer approved by waterproofing membrane manufacturer].

B. Plaza-Deck Paving: Obtain plaza-deck pavers [and paver pedestal assembly] from single source from single manufacturer for consistent quality in appearance and physical properties.

2.2 RUBBER WATERPROOFING

A. Single-Component, Rubber Waterproofing: ASTM C836/C836M; solvent based; coal-tar free.

1. Hydrostatic-Head Resistance: 69.3 ft. minimum; [ASTM C1306/C1306M][ASTM E154/E154M].

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2.3 ACCESSORY WATERPROOFING SYSTEM MATERIALS

A. General: Accessory materials as recommended in writing by waterproofing manufacturer for intended use and compatible with one another and with waterproofing.

B. Primer: Liquid [waterborne][solvent-borne] primer as recommended in writing for substrate by waterproofing manufacturer.

C. Surface Conditioner: Liquid, waterborne surface conditioner as recommended in writing for substrate by waterproofing manufacturer.

D. Sheet Flashing: Manufacturer's standard flashing sheet.

1. Adhesive: Manufacturer's standard contact adhesive.

E. Metal Termination Bars: Manufacturer's standard, predrilled, stainless steel or aluminum termination bars; approximately 1 by 1/8 inch thick; with stainless steel anchors.

F. Reinforcing Fabric: Manufacturer's standard fiberglass mesh or spun-bonded polyester fabric.

G. Detailing Seam Tape: Manufacturer's standard detailing tape.

H. Joint Sealant: [Single-component][Multicomponent] polyurethane sealant, compatible with waterproofing; [ASTM C920, Type M, Class 25 or greater; Grade NS for sloping and vertical applications and Grade P for deck applications; Use NT exposure][as specified in Section 079200 "Joint Sealants"]<Insert requirement>; and as recommended in writing by waterproofing manufacturer for substrate and joint conditions.

I. Backer Rod: Closed-cell polyethylene foam.

2.4 PROTECTION COURSE

A. Protection Course, Asphaltic: ASTM D6506/D6506M; semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners:

1. Thickness: Nominal [1/8 inch][1/4 inch][1/8 inch for vertical applications; 1/4 inch elsewhere].

B. Protection Course, Extruded-Polystyrene Board Insulation, Faced: Fan folded, faced on [one side][or][both sides] with plastic film, nominal thickness 1/4 inch, with compressive strength of not less than 8 psi when tested in accordance with ASTM D1621/D1621M, and maximum water absorption by volume of 0.6 percent when tested in accordance with ASTM C272/C272M.

C. Protection Course, Extruded-Polystyrene Board Insulation, Unfaced: ASTM C578,

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Type X, 1/2 inch thick.

D. Protection Course, Molded-Polystyrene Board Insulation: ASTM C578, Type I, 0.90 lb/cu. ft. minimum density, 1-inch minimum thickness.

2.5 ELECTRONIC LEAK-DETECTION (ELD) MATERIALS

A. Conductive Medium: Electrically conductive material specifically designed to enable ELD testing procedures as approved in writing by waterproofing membrane manufacturer.

1. Conductive medium to be located directly under waterproofing membrane in accordance with ASTM D7877 and ASTM D8231.

B. Moisture-Monitoring System: Permanently embedded, continuously monitored moisture-detection system.

1. Sensors measuring moisture content to be placed within waterproofing system and connected to a monitoring program, with a notification indicating location of breach.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that concrete has cured and aged for minimum time period as recommended in writing by waterproofing manufacturer.
2. Verify that substrate is visibly dry and within the moisture limits as recommended in writing by waterproofing manufacturer. Test for capillary moisture by plastic sheet method in accordance with ASTM D4263.

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

3.2 PREPARATION

A. Clean, prepare, and treat substrates in accordance with waterproofing manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

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D. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.

1. Abrasive blast clean concrete surfaces uniformly to expose top surface of fine aggregate in accordance with ASTM D4259 with a self-contained, recirculating, blast-cleaning apparatus. Remove material to provide a sound surface free of laitance, glaze, efflorescence, curing compounds, concrete hardeners, or form-release agents. Remove remaining loose material and clean surfaces in accordance with ASTM D4258.

E. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, holes, and other voids.

F. Coordinate with Owner for impact to air-intake equipment in the vicinity of the Work. Cover or filter air-intake louvers before proceeding with work that could affect indoor air quality or that could activate smoke detectors in the ductwork.

3.3 PREPARATION AT TERMINATIONS, PENETRATIONS, AND CORNERS

A. Prepare surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, sleeves, and corners in accordance with waterproofing manufacturer's written instructions and to recommendations in [ASTM C898/C898M][and][ASTM C1471/C1471M].

3.4 TREATMENT OF JOINTS AND CRACKS

A. Prepare, treat, rout, and fill joints and cracks in substrate in accordance with waterproofing manufacturer's written instructions and recommendations in [ASTM C898/C898M][and][ASTM C1471/C1471M]. Before coating surfaces, remove dust and dirt from joints and cracks in accordance with ASTM D4258.

1. Comply with ASTM C1193 for joint-sealant installation.
2. Apply bond breaker on sealant surface, beneath preparation strip.
3. Prime substrate along each side of joint and apply a single thickness of preparation strip at least 6 inches wide along each side of joint. Apply waterproofing in two separate applications and embed a joint-reinforcing strip in first preparation coat.

B. Install sheet flashing and bond to deck and wall substrates where required in accordance with waterproofing manufacturer's written instructions.

1. Extend sheet flashings for [4 inches]<Insert dimension> onto perpendicular surfaces and items penetrating substrate.

3.5 INSTALLATION OF ELECTRONIC LEAK-DETECTION (ELD) MATERIALS

A. Install conductive medium directly under waterproofing membrane in accordance with ASTM D7877 and ASTM D8231.

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B. Install sensors, connections, and accessory items required for complete continuously monitored moisture-detection system in accordance with waterproofing manufacturer's written installation instructions.

3.6 INSTALLATION OF COLD FLUID-APPLIED WATERPROOFING

A. General: Apply waterproofing in accordance with manufacturer's written instructions and to recommendations in [ASTM C898/C898M][and][ASTM C1471/C1471M].

B. Start installing waterproofing in presence of manufacturer's technical representative.

C. Apply primer over prepared substrate at manufacturer's recommended rate and allow it to dry.

D. Unreinforced Waterproofing Membrane Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.

1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases and pinholes, with a minimum dry film thickness of [60 mils][90 mils][120 mils]<Insert dimension>.
2. Apply waterproofing to prepared wall terminations and vertical surfaces.
3. Verify manufacturer's recommended wet film thickness of waterproofing every 100 sq. ft..

E. Reinforced Waterproofing Membrane Applications: Mix materials and apply waterproofing by roller, notched squeegee, trowel, or other suitable application method.

1. Apply first coat of waterproofing, embed membrane-reinforcing fabric, and apply second coat of waterproofing to completely saturate reinforcing fabric and to obtain a seamless reinforced membrane free of entrapped gases and pinholes, with an average dry film total thickness of [70 mils][80 mils][90 mils][120 mils]<Insert dimension>.
2. Apply reinforced waterproofing to prepared wall terminations and vertical surfaces.
3. Verify manufacturer's recommended wet film thickness of waterproofing every 100 sq. ft..

F. Cure waterproofing, taking care to prevent contamination and damage to membrane.

3.7 INSTALLATION OF PROTECTION COURSE

A. Cover waterproofing with protection course with butted joints before membrane is subject to [backfilling][construction or vehicular traffic].

1. For horizontal applications, install protection course loose laid over fully cured membrane.
2. For vertical applications, set protection course in nominally cured membrane, which will act as an adhesive. If membrane cures before application of protection

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course, use adhesive.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: [Owner will engage][Engage] a qualified testing agency to perform tests and inspections:

1. Testing agency to verify thickness of waterproofing during application for each [600 sq. ft.]<Insert dimension> of installed waterproofing or part thereof.

B. Perform the following tests before overlying construction is placed:

1. ELD Testing: Testing agency surveys entire horizontal waterproofed area and flashings to locate discontinuities in the system assembly using ELD in accordance with ASTM D7877 and ASTM D8231.

a. After testing, repair areas of discontinuities, repeat tests, and make further repairs until waterproofing and flashing installations are contiguous.

1) Cost of retesting is Contractor's responsibility.

b. Testing agency to prepare survey report indicating locations of initial discontinuities, if any.

2. Flood Testing: Flood test each completed horizontal waterproofed area for leaks, in accordance with recommendations in ASTM D5957. Install temporary containment assemblies, plug, or dam drains, and flood with potable water.

a. Flood to an average depth of [2-1/2 inches]<Insert depth> with a minimum depth of [1 inch]<Insert depth> and not exceeding a depth of [4 inches]<Insert depth>. Maintain 2 inches of clearance from top of base flashing.
b. Flood each area for [24][48][72] hours.
c. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing and flashing installations are watertight.

1) Cost of retesting is the responsibility of Contractor.

d. Testing agency to prepare survey report indicating locations of initial leaks, if any, and final survey report.

C. Manufacturer's Field Service: Engage a [full-time] site representative qualified by waterproofing system manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components and to furnish daily reports to Architect.

1. Final Inspection: Arrange for waterproofing system manufacturer's technical personnel to inspect system installation on completion, in presence of Architect, and to prepare inspection report.
2. Notify Architect [and Owner] 48 hours in advance of date and time of inspection.

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3. Repair or remove and replace components of waterproofing system where inspections indicate that they do not comply with specified requirements.

D. Additional Tests and Inspections:

1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.
2. Waterproofing system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 PROTECTION, REPAIR, AND CLEANING

A. Protect waterproofing system from damage and wear during remainder of construction period.

B. Protect installed [protection course][drainage panels] from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where material is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

C. Correct deficiencies in or remove waterproofing system that does not comply with requirements, repair substrates, and repair or reinstall waterproofing system to a condition free of damage and deterioration at time of Substantial Completion and in accordance with warranty requirements.

D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071416

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SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board insulation.
2. Molded (expanded) polystyrene foam-plastic board insulation.
3. Graphite-polystyrene foam-plastic board insulation.
4. Glass-fiber blanket insulation.
5. Mineral-wool blanket insulation.
6. Spray-applied cellulosic insulation.
7. Reflective insulation and radiant barriers.
8. Rigid vacuum insulation.
9. Glass-wool vacuum insulation.

B. Related Requirements:

1. Section 042000 "Unit Masonry" for insulation installed in masonry cells.
2. Section 061600 "Sheathing" for foam-plastic board sheathing installed directly over wood or steel framing.
3. [Section 071326 "Self-Adhering Sheet Waterproofing"][Section 071353 "Elastomeric Sheet Waterproofing"][Section 071354 "Thermoplastic Sheet Waterproofing"][Section 071413 "Hot Fluid-Applied Rubberized Asphalt Waterproofing"][Section 071416 "Cold Fluid-Applied Waterproofing"] for insulated drainage panels installed with plaza deck insulation.
4. Section 072119 "Foamed-in-Place Insulation" for spray-applied polyurethane foam insulation.
5. [Section 092300 "Gypsum Plastering"][Section 092400 "Portland Cement Plastering"][Section 092613 "Gypsum Veneer Plastering"][Section 092900 "Gypsum Board"] for sound attenuation blanket used as acoustic insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party Certified Life Cycle Assessment: For each product.

1.3 INFORMATIONAL SUBMITTALS

A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in

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each element of the building thermal envelope.

1. For blown-in or sprayed fiberglass and cellulosic-fiber loose-fill insulation, indicate initial installed thickness, settled thickness, settled R-value, installed density, coverage area, and number of bags installed.
2. Sign, date, and post the certification in a conspicuous location on Project site.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Research Reports: For foam-plastic insulation, from ICC-ES.

1.4 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 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than [Class A, 25 and 450][Class B, 75 and 450][Class C, 200 and 450] when tested in accordance with ASTM E84.

B. Fire-Resistance Ratings: Comply with ASTM E119 or UL 263; 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 listings of another qualified testing agency.

C. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

D. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

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E. Thermal-Resistance Value (R-Value): [R-value as indicated on Drawings][R-value as indicated below]<Insert R-value> in accordance with ASTM C518.

1. R-Value at <Insert location>: <Insert R-value>.

F. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent.

2.2 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION (XPS)

A. Extruded Polystyrene Board Insulation, Type VII: ASTM C578, Type VII, 60 psi minimum compressive strength.

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

a. [DiversiFoam Products]
b. [DuPont de Nemours, Inc.]
c. [Kingspan Insulation LLC]
d. [Owens Corning]
e. [The Dow Chemical Company]
f. <Insert manufacturer's name>

2.3 GLASS-FIBER BLANKET INSULATION

A. Glass-Fiber Blanket Insulation, Foil Faced: ASTM C665, Type III (reflective faced), Class B (faced surface with a flame-propagation resistance of 0.12 W/sq. cm); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

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

a. [CertainTeed; SAINT-GOBAIN]
b. [Johns Manville; a Berkshire Hathaway company]
c. [Knauf Insulation]
d. [Owens Corning]
e. <Insert manufacturer's name>

2.4 MINERAL-WOOL BLANKET INSULATION

A. Mineral-Wool Blanket Insulation, Reinforced-Foil Faced: ASTM C665, Type III (reflective faced); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

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

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a. [Johns Manville; a Berkshire Hathaway company]
b. [Owens Corning]
c. <Insert manufacturer's name>

2.5 MINERAL-WOOL BOARD INSULATION

A. Mineral-Wool Board Insulation, Type IVA : ASTM C612, Type IVA; unfaced.

1. Nominal Density: 12 lb/cu. ft..

B. Mineral-Wool Board Insulation, Type IVB : ASTM C612, Type IVB; unfaced.

1. Nominal Density: 12 lb/cu. ft..

2.6 SPRAY-APPLIED CELLULOSIC INSULATION

A. Self-Supported, Spray-Applied Cellulosic Insulation: ASTM C1149, Type I (materials applied with liquid adhesive; suitable for either exposed or enclosed applications), chemically treated for flame-resistance, processing, and handling characteristics.

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

a. [Greenfiber, LLC]
b. [Hamilton Manufacturing, Inc. (HMI)]
c. [International Cellulose Corp.]
d. <Insert manufacturer's name>

2.7 INSULATION FASTENERS

A. Insulation Fastener Accessories: Provide double-pointed weld pins, lagging pins, quilting pins, duct liner pins, insulation hangers, specialty washers, special caps, j-hooks, capacitor discharge annular weld pins, capacitor discharge acoustical lagging pins, and other accessory materials that are recommended in writing by insulation fastener manufacturer to produce complete insulation supports.

2.8 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

B. Miscellaneous Application Accessories:

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1. 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.
2. Crack Sealer: Closed-cell insulating foam in aerosol dispenser recommended in writing by insulation manufacturer for filling gaps in board insulation.
3. Curtain-Wall Insulation Clips: Z-shaped galvanized steel as recommended in writing by insulation manufacturer.
4. 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.
5. Detailing Foam Insulation for Voids: Urethane foam complying with AAMA 812, low expansion pressure suitable for filling insulation gaps and voids adjacent to openings to protect against water, air, and sound intrusion.
6. Tapes for Reflective Insulation and Barriers:

    a. Aluminum-foil tape for repairs or splicing material.
    b. Double-sided tape for adhering to metal framing or overlapping material.
    c. Reinforced-foil tape for sealing tears or cuts in sheet vapor barrier.

7. Clip-and-Pin Components:

    a. Beam/Bar Joist Clips: For beams, bar joists, and Z-type purlins.
    b. C-Purlin Clips: For C-type purlins.
    c. Angle Clips: For sidewalks and floors.
    d. Tube Clips: For wood beams and metal tubular framing.
    e. Locking Washers: Aluminum; white to match reflective bubble insulation facing colors.

8. Wire Mesh Lath Support for Insulation: ASTM C1032.

    a. Material: Woven wire lath 1-1/2-inch hexagonal-shaped mesh with minimum 0.0510-inch- diameter, galvanized-steel wire.

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 those that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products, applications and applicable codes.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

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C. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. 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 in accordance with 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 in accordance with manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

1. If not otherwise indicated, extend insulation a minimum of 36 inches in from exterior walls.

3.4 INSTALLATION OF FOUNDATION WALL INSULATION

A. Butt panels together for tight fit.

B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive in accordance with anchor manufacturer's written instructions.
2. Space anchors in accordance with insulation manufacturer's written instructions for insulation type, thickness, and application.
3. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
4. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.
5. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing in accordance with manufacturer's written instructions.

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3.5 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended in writing by manufacturer.

1. Fit courses of insulation between [wall ties and other] obstructions, with edges butted tightly in both directions, and with faces flush.
2. Press units firmly against inside substrates.
3. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

B. Cellular-Glass Structural Insulating Blocks:

1. Verify manufacturer-recommended cure time for air and water barrier system and waterproofing before installing structural insulating block.
2. Install a single layer of cellular-glass structural insulating block with facers on top and bottom surfaces fully embedded into mortar set on brick ledge in accordance with manufacturer's written instructions.
3. Install cellular-glass structural insulating block maximum sizes to minimize joints.
4. Locate joints square to framing members. Do not cantilever cellular-glass structural insulating block.
5. Butt joints of cellular-glass structural insulating block with no gaps or mortar between joints.
6. Insulation board edges are to be butted together tightly and fit around openings and penetrations. Install square edges to fit square and tight.
7. Extend insulation in single course to cover entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Do not drill.

C. Mineral-Wool Board Insulation: Install insulation fasteners 4 inches from each corner of board insulation, at center of board, and as recommended by manufacturer.

1. Fit courses of insulation between [masonry wall ties and other] obstructions, with edges butted tightly in both directions, and with faces flush.
2. Press units firmly against inside substrates.

3.6 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members in accordance with 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

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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. Where glass-fiber blankets are indicated for sound attenuation above ceilings, install unfaced blanket insulation over ceiling area in thickness indicated. Where partitions occur, extend insulation up either side of partition.
7. For wood-framed construction, install blankets in accordance with ASTM C1320 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.

8. 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 interior of construction.
    b. Interior Walls: Set units with facing placed toward areas of high humidity.

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. Detailing Foam Insulation for Voids: Apply in accordance with manufacturer's written instructions.

C. Loose-Fill Insulation: Apply in accordance with ASTM C1015 and manufacturer's written instructions.

1. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.
2. For cellulosic-fiber loose-fill insulation, comply with CIMA's Technical Bulletin #2, "Standard Practice for Installing Cellulose Building Insulation."

D. Spray-Applied Cellulosic Insulation: Apply spray-applied insulation in accordance with manufacturer's written instructions.

1. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked.
2. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

3.7 INSTALLATION OF BOARD INSULATION

A. Install board insulation in accordance with manufacturer's written instructions per project applications and conditions.

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3.8 INSTALLATION OF REFLECTIVE AND RADIANT BARRIERS INSULATION

A. Install sheet reflective insulation in accordance with ASTM C727.

B. Install sheet radiant barriers in accordance with ASTM C1744.

C. Install interior radiation control coating system in accordance with ASTM C1321.

3.9 INSTALLATION OF VACUUM INSULATION

A. Install vacuum insulation panels in accordance with manufacturer's written instructions.

3.10 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. 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

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SECTION 072500 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Building wrap.
2. Drainage wrap.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

B. Product Data Submittals: For [building wrap][drainage wrap], include data on air and water-vapor permeance based on testing in accordance with referenced standards.

C. Shop Drawings: Show details of [building paper][building wrap][drainage wrap] at terminations, openings, and penetrations. Show details of flexible flashing applications.

D. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party Certified Life Cycle Assessment: For each product.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For [water-resistive barrier][and][flexible flashing], from ICC-ES.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, certified, or licensed by the weather barrier system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

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1.6 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed in accordance with manufacturer's written installation instructions and warranty requirements.

1.7 WARRANTY

A. Warranty Period: [10][15][20]<Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 WEATHER BARRIERS

A. Building Wrap: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested in accordance with ASTM E84; UV stabilized; and acceptable to authorities having jurisdiction.

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

    a. Benjamin Obdyke Incorporated
    b. DuPont de Nemours, Inc.
    c. PrimeSource Building Products, Inc.

2. Building Wrap Type: [Type I, ASTM E2556/E2556M][Type I, ASTM E1677][Type II, ASTM E2556/E2556M][ICC-ES AC38].
3. Composition Type: [Perforated woven polyolefin][Polypropylene woven fabric with coating][Nonperforated, nonwoven polyolefin].
4. Water-Vapor Permeance: Minimum 20 perms in accordance with ASTM E96/E96M, Desiccant Method (Procedure A).
5. Air Permeance: Not more than 0.001 cfm/sq. ft. at 1.57 lbf/sq. ft. when tested in accordance with ASTM E2178.
6. Allowable UV Exposure Time: Not more than 180 days.
7. Flame Propagation Test: Materials and construction to be as tested in accordance with NFPA 285.

2.2 ACCESSORY MATERIALS

A. Requirement: Provide primers, fasteners, seam tapes, flashing, transition strips, termination strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by weather barrier manufacturer to produce a complete weather barrier assembly and that are compatible with primary weather barrier material and adjacent construction to which they may seal.

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B. Drainage Accessories: [Furring strips]<Insert component> installed between water-resistive barrier and exterior cladding to create a continuous open space behind exterior cladding.

PART 3 - EXECUTION

3.1 INSTALLATION OF WEATHER BARRIERS

A. Weather Barriers:

1. Building Wrap or Drainage Wrap: Comply with manufacturer's written instructions and warranty requirements.
2. Drainage Material: Comply with manufacturer's written instructions.

B. Install weather barrier accessories for a complete installation with weather barriers in accordance with manufacturers written instructions.

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SECTION 072600 - VAPOR RETARDERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polyethylene vapor retarders.
2. Reinforced-polyethylene vapor retarders.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for under-slab vapor retarders.
2. Section 072100 "Thermal Insulation" for vapor retarders integral with insulation products.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Polyethylene vapor retarders.
2. Reinforced-polyethylene vapor retarders.
3. Fire-retardant, reinforced-polyethylene vapor retarders.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 POLYETHYLENE VAPOR RETARDERS

A. Polyethylene Vapor Retarders: ASTM D4397, 6-mil- thick sheet, with maximum permeance rating of 0.1 perm.

2.2 REINFORCED-POLYETHYLENE VAPOR RETARDERS

A. Reinforced-Polyethylene Vapor Retarders: Sheet with outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nylon cord or polyester scrim and weighing not less than [20 lb/1000 sq. ft.]<Insert weight>, with maximum permeance rating of 0.1 perm.

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

    a. [ISI Building Products]
    b. [Reef Industries, Inc.]
    c. [Viaflex]
    d. [W. R. Meadows, Inc]
    e. <Insert manufacturer's name>

2.3 ACCESSORIES

A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

B. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.

C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

3.2 INSTALLATION OF VAPOR RETARDERS ON FRAMING

A. Place vapor retarders on side of construction indicated on Drawings.

B. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

C. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.

D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

E. Repair tears or punctures in vapor retarders immediately before concealment by other

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work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.3 INSTALLATION OF VAPOR RETARDERS IN CRAWL SPACES

A. Install vapor retarders over prepared grade. Lap joints a minimum of 12 inches and seal with manufacturer's recommended tape. Install second layer over pathways to equipment.

B. Extend vapor retarder over footings and seal to foundation wall or grade beam with manufacturer's recommended tape.

1. Extend vapor retarder vertically minimum [16 inches][24 inches]<Insert dimension> above top of footing.

C. Seal around penetrations such as utilities and columns in order to create a monolithic, airtight membrane at grade surface, perimeter, and all vertical penetrations.

3.4 PROTECTION

A. Protect vapor retarders from damage until concealed by permanent construction.

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SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. High-build air barriers, vapor retarding.

B. Related Requirements:

1. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.
2. Section 072500 "Weather Barriers" for weather barriers, including flexible flashing and building wraps with air-barrier properties.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.3 ACTION SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.

1. High-build air barriers, vapor retarding.

B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer. Include list of ABAA-certified installers and

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supervisors employed by Installer, who work on Project.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

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

1. Installer to be licensed by ABAA in accordance with ABAA's Quality Assurance Program and to employ ABAA-certified installers and supervisors on Project.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain primary air-barrier materials and air-barrier accessories from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction to

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be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies to be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations , tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested in accordance with ASTM E2357.

C. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. pressure difference; ASTM E2178.

D. Ultimate Elongation: Minimum 250 percent; ASTM D412, Die C.

E. Adhesion to Substrate: Minimum 30 lbf/sq. in. when tested in accordance with ASTM D4541.

F. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

G. UV Resistance: Can be exposed to sunlight for 90 days in accordance with manufacturer's written instructions.

2.3 HIGH-BUILD AIR BARRIERS, VAPOR RETARDING

A. High-Build, Vapor-Retarding Air Barrier, Modified Bituminous Type: Modified bituminous membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils or thicker over smooth, void-free substrates.

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 Coatings & Waterproofing Inc
    b. Carlisle Construction Materials; Carlisle Companies: Barriseal
    c. Henry; a Carlisle Company
    d. Tremco Incorporated
    e. W. R. Meadows, Inc

B. Vapor Permeance: Maximum 0.1 perm; ASTM E96/E96M, Procedure A, Desiccant Method.

2.4 HIGH-BUILD AIR BARRIERS, VAPOR PERMEABLE

A. Vapor Permeance: Minimum 5 perms; ASTM E96/E96M, Procedure A, Desiccant Method.

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2.5 ACCESSORY MATERIALS

A. Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

B. Primer: Liquid solvent-borne primer recommended for substrate by air-barrier material manufacturer.

C. Stainless Steel Sheet: ASTM A240/A240M, Type 304, 0.0187 inch thick, and Series 300 stainless steel fasteners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
3. Verify that substrates are visibly dry and free of moisture. Test concrete substrates for capillary moisture by plastic sheet method in accordance with ASTM D4263.
4. Verify that masonry joints are flush and completely filled with mortar.

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

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate in accordance with manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.

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E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

H. Bridge isolation joints discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement in accordance with manufacturer's written instructions and details.

3.3 INSTALLATION OF ACCESSORIES

A. Install accessory materials in accordance with air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.

B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.

1. Transition Strip: Roll firmly to enhance adhesion.

F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors,

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and miscellaneous penetrations of air-barrier material with foam sealant.

G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

H. Seal top of through-wall flashings to air barrier with an additional 6-inch- wide, transition strip.

I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.4 INSTALLATION OF PRIMARY AIR-BARRIER MATERIAL

A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier in accordance with air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.

1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.

B. High-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply air-barrier material in full contact around protrusions such as masonry ties.

1. Vapor-Retarding, High-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, but not less than 35 mils, applied in one or more equal coats.
2. Vapor-Permeable, High-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, but not less than 35 mils, applied in one or more equal coats.

C. Do not cover air barrier until it has been tested and inspected by testing agency.

D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.5 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

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B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Air-barrier dry film thickness.
3. Continuous structural support of air-barrier system has been provided.
4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
5. Site conditions for application temperature and dryness of substrates have been maintained.
6. Maximum exposure time of materials to UV deterioration has not been exceeded.
7. Surfaces have been primed, if applicable.
8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
9. Termination mastic has been applied on cut edges.
10. Strips and transition strips have been firmly adhered to substrate.
11. Compatible materials have been used.
12. Transitions at changes in direction and structural support at gaps have been provided.
13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
14. All penetrations have been sealed.

D. Tests: As determined by testing agency from among the following tests:

1. Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage in accordance with ASTM E1186, chamber depressurization using detection liquids.
2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate in accordance with ASTM E783.
3. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate in accordance with ASTM D4541 for each 600 sq. ft. of installed air barrier or part thereof.

E. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, in accordance with manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

F. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

G. Prepare test and inspection reports.

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3.6 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, in accordance with manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials in accordance with air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

C. Remove masking materials after installation.

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SECTION 074113.16 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vertical-rib, snap-joint, standing-seam metal roof panels.
2. Roof insulation.
3. Cover board.
4. Underlayment.

B. Related Requirements:

1. Section 074293 "Soffit Panels" for metal panels used in horizontal soffit applications.
2. Section 077253 "Snow Guards" for prefabricated devices designed to hold snow on the roof surface, allowing it to melt and drain off slowly.

1.2 DEFINITIONS

A. Structural Standing-Seam Metal Roof Panel System: A roof system designed to resist positive and negative loads applied normal to the metal roof panel surface without the benefit of a supporting deck or sheathing.

1.3 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

B. Coordinate metal roof panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]<Insert location>.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal roof panel Installer, metal roof panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal roof panels, including installers of roof accessories and roof-mounted equipment.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and

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avoid delays.

3. Review methods and procedures related to metal roof panel installation, including manufacturer's written installation instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review loading limitations of supporting structure during and after roofing.
6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal roof panels.
7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
8. Review temporary protection requirements for metal roof panel systems during and after installation.
9. Review procedures for repair of metal roof panels damaged after installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.5 ACTION SUBMITTALS

A. Product Data:

1. For standing-seam metal roof panels. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal roof panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: Manufacturer's standard color charts, showing full range of available colors for each type of exposed finish.

1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: Actual sample of finished products for each type of exposed finish for metal roof panels and metal panel accessories.

1. Size: [Manufacturers' standard size]<Insert size>.

1.6 INFORMATIONAL SUBMITTALS

A. Certificates for portable roll-forming equipment.

B. Product Test Reports: For standing-seam metal roof panels, for tests performed by a qualified testing agency.

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C. Field quality-control reports.

D. Qualification Statements: For roof installers.

E. Sample warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal roof panels.

1.8 QUALITY ASSURANCE

A. Roof Installer Qualifications: Entity that employs [a supervisor who is an NRCA ProCertified Roofing Foreman or installers who are NRCA ProCertified Metal Panel Roof Systems Installers][a supervisor who is an NRCA ProCertified Roofing Foreman][a supervisor who is an NRCA ProCertified Roofing Foreman and not less than 20 percent of installers who are NRCA ProCertified Metal Panel Roof Systems Installers].

B. Portable Roll-Forming Equipment Certification: UL-certified, portable roll-forming equipment capable of producing metal roof panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of Work.

1.9 MOCKUPS

A. 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 area and eave [, including fascia,][and soffit] as shown on Drawings; approximately [48 inches][12 ft.]<Insert dimension> square by full thickness, including attachments, underlayment, and accessories.
2. Build mockups for typical roof area only, including accessories.

    a. Size: [12 ft. long by 6 ft.]<Insert dimension>.
    b. [Each type of exposed seam and seam termination]<Insert mockup item>.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal roof panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation

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and handling.

B. Unload, store, and erect metal roof panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal roof panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness, with positive slope for drainage of water. Do not store metal roof panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal roof panels during installation.

E. Copper Roof Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.11 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal roof panels to be performed in accordance with manufacturers' written installation instructions and warranty requirements.

1.12 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal roof panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metal and other materials beyond normal weathering.

2. Warranty Period: [Two]<Insert number> years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer agrees to repair finish or replace metal roof panels that show 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 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: [10][20]<Insert number> years from date of Substantial Completion.

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C. Special Weathertightness Warranty: Manufacturer agrees to repair or replace standing-seam metal roof panel systems that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: [20]<Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal roof panel systems capable of withstanding the effects of the following loads when tested in accordance with ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: [As indicated on Drawings]<Insert loads>.
3. Deflection Limits: For wind loads, no greater than [1/180][1/240]<Insert deflection> of the span.
4. Structural Standing-Seam Steel Roof Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1514.
5. Structural Standing-Seam Aluminum Roof Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1637.
6. <Insert other performance requirements>.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested in accordance with ASTM E1680 [or ASTM E283/E283M] at the following test-pressure difference:

1. Test-Pressure Difference: [1.57 lbf/sq. ft.][6.24 lbf/sq. ft.].

C. Water Penetration under Static Pressure: No water penetration when tested in accordance with ASTM E1646 [or ASTM E331] at the following test-pressure difference:

1. Test-Pressure Difference: [2.86 lbf/sq. ft.][6.24 lbf/sq. ft.].

D. Watertightness: No water penetration when tested in accordance with ASTM E2140 for hydrostatic-head resistance.

E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: [UL 30][UL 60][UL 90].

F. FM Approvals Listing: Provide metal roof panels and component materials that comply with requirements in FM Approvals 4471 as part of a metal panel roofing system and that are listed in FM's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.

1. Fire/Windstorm Classification: Class 1A- [60][75][90][105][120]<Insert number>.
2. Hail Resistance: [MH][SH].

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G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: [120 deg F, ambient; 180 deg F, material surfaces]<Insert temperature range>.

H. Energy Performance:

1. Provide metal roof panels meeting one of the following requirements when tested in accordance with CRRC-1:

a. Three-year, aged solar reflectance of not less than [0.55]<Insert value> and emissivity of not less than [0.75]<Insert value>.
b. Three-year, aged Solar Reflectance Index (SRI) of not less than [64]<Insert value> when calculated in accordance with ASTM E1980.

2.2 STANDING-SEAM METAL ROOF PANELS, GENERAL

A. Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with seamed joint type indicated and mechanically attaching panels to supports using concealed fasteners in side laps. Include all accessories required for weathertight installation.

B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent.

2.3 VERTICAL-RIB, SNAP-JOINT, STANDING-SEAM METAL ROOF PANELS

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

1. ATAS International, Inc.
2. Garland Company, Inc. (The)
3. Merchant & Evans Inc.

B. Metal Roof Panels: Formed with vertical ribs at panel edges; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and snapping panels together.

1. Structural Support: Over [solid deck][open framing].
2. Material: Metallic-coated steel.
3. Panel Profile: Intermediate stiffening ribs symmetrically spaced between ribs.
4. Panel Coverage:
[10 inches][12 inches][14 inches][16 inches][18 inches][24 inches]<Insert dimension>.
5. Panel Height: [1.0 inch][1.5 inches][1.75 inches]<Insert dimension>.
6. Clips: Two piece, floating, designed to accommodate thermal movement.

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a. Steel Clips: 0.064-inch- nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
b. Stainless Steel Clips: 0.0625-inch- thick, stainless steel sheet.
c. Clip Spacing: As indicated on approved Shop Drawings.

2.4 METAL ROOF PANEL MATERIAL

A. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with minimum ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with minimum ASTM A792/A792M, Class AZ50 coating designation; structural quality. Sheet prepainted by the coil-coating process to comply with ASTM A755/A755M.

1. Nominal Thickness: 0.040 inch.
2. Surface: Smooth, flat texture.
3. Exterior Finish: Two-coat fluoropolymer.
4. Color: As selected by Architect from manufacturer's full range.

B. Aluminum Sheet: Coil-coated sheet, ASTM B209/B209M, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

1. Thickness: 0.032 inch.
2. Surface: Smooth, flat texture.
3. Exterior Finish: Two-coat fluoropolymer.
4. Color: As selected by Architect from manufacturer's full range.

2.5 VAPOR RETARDER

A. Rubberized-Asphalt-Sheet Vapor Retarder, Self-Adhering: ASTM D1970/D1970M polyethylene film laminated to layer of rubberized asphalt adhesive, minimum 40-mil total thickness; maximum permeance rating of 0.1 perm; cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor-retarder manufacturer.

B. Butyl Rubber Sheet Vapor Retarder, Self-Adhering: Polyethylene film laminated to layer of butyl rubber adhesive, minimum 30-mil total thickness; maximum permeance rating of 0.1 perm; cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor-retarder manufacturer.

2.6 ROOF INSULATION

A. Insulation over Solid Deck:

1. Polyisocyanurate Board Insulation: ASTM C1289, Type II, [Class 1 felt facer][Class 2 coated glass-fiber facer][Class 3 uncoated glass-fiber facer] on both major surfaces.

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

1) Atlas Polyiso Roof and Wall Insulation
2) Carlisle SynTec Systems; a Carlisle Company
3) CertainTeed; SAINT-GOBAIN
4) Johns Manville; a Berkshire Hathaway company

b. Compressive Strength: Grade 3, 25 psi.
c. Size: 48 by 96 inches.
d. Thickness:

1) Base Layer: [1-1/2 inches]<Insert thickness>.
2) Upper Layer: <Insert thickness>.

B. Insulation over Open Framing:

1. Mineral-Fiber-Blanket Insulation: ASTM C665, type indicated below; consisting of fibers manufactured from glass, slag wool, or rock wool.

a. Nonreflective Faced: Type II (blankets with nonreflective membrane covering), Category 1 (membrane is a vapor retarder), Class A (membrane-faced surface with a flame-spread index of 25 or less).
b. Reflective Faced: Type III (blankets with reflective membrane covering), Category 1 (membrane is a vapor retarder), Class A (membrane-faced surface with a flame-spread index of 25 or less).
c. Unfaced: Type I (blankets without membrane covering), passing ASTM E136 for combustion characteristics.

2.7 COVER BOARD

A. Cellulosic-Fiber Cover Board: ASTM C208, Type II, Grade 2, high-density cellulosic-fiber insulation board, having a minimum compressive strength of 40 psi.

1. Thickness: [1/2 inch][1 inch]<Insert thickness>.
2. Surface Finish: [Primed one side][Primed two sides with non-asphaltic primer][Integral coating, six sides][Unprimed]<Insert finish>.

B. Oriented Strand Board: DOC PS 2, Exposure 1, 7/16 inch thick.

C. Fiber-Reinforced Cementitious Cover Board: ASTM C1325, fiber-mat-reinforced cementitious board.

1. Thickness: [7/16 inch][1/2 inch][5/8 inch].

D. High-Density Polyisocyanurate Cover Board: ASTM C1289 Type II, Class 4, Grade 1, 1/2 inch thick, with a minimum compressive strength of 80 psi.

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2.8 UNDERLAYMENT

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

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

    a. ATAS International, Inc.
    b. Carlisle WIP Products; a brand of Carlisle Construction Materials
    c. Henry; a Carlisle Company

2. Thermal Stability: Stable after testing at 220 deg F; ASTM D1970/D1970M.
3. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D1970/D1970M.

B. Felt Underlayment: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felts.

C. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.9 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645; cold-formed, metallic-coated steel sheet, minimum ASTM A653/A653M, G90 hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 coating designation. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Roof Panel Accessories: Provide components required for a complete, weathertight metal roof panel system including trim, copings, fasciae, mullions, sills, corner units, fasteners, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.
2. Backing Plates: Provide metal backing plates at roof panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal roof panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system

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as adjacent metal roof panels.

D. Gutters: Formed from same material as metal roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- long sections, of size and metal thickness in accordance with manufacturer's recommendations. Furnish gutter supports spaced a maximum of 36 inches o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match roof fascia and rake trim.

E. Downspouts: Formed from same material as metal roof panels. Fabricate in 10 ft. long sections, complete with formed elbows and offsets, of size and metal thickness in accordance with manufacturer's recommendations. Finish downspouts to match gutters.

F. Roof Curbs: Fabricated from same material as metal roof panels, [0.048-inch]<Insert dimension> nominal thickness; with bottom of skirt profiled to match metal roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb subframing of 0.060-inch- nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.

1. Insulate roof curb with 1-inch- thick, rigid insulation.

G. Roof Panel Fasteners: Self-tapping screws designed to withstand design loads.

H. Roof Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with metal roof panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal roof panels and remain weathertight; and as recommended in writing by metal roof panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.10 FABRICATION

A. Fabricate and finish metal roof panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-site Fabrication: Subject to compliance with requirements of this Section, metal roof panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate in accordance with equipment manufacturer's written instructions and to comply with details shown.

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C. Provide roof panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal roof panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for other than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with manufacturer's recommendations.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not permitted on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal roof panel manufacturer.

a. Size: As recommended by metal roof panel manufacturer for application, but not less than thickness of metal being secured.

2.11 FINISHES

A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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 same piece are unacceptable. 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. Steel Roof Panels and Accessories:

1. Two-Coat Fluoropolymer: 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 [for seacoast and severe environments].
2. Three-Coat Fluoropolymer: Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions [for seacoast and severe environments].

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3. Mica Fluoropolymer: Two-coat fluoropolymer finish with suspended mica flakes 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 [for seacoast and severe environments].
4. Metallic Fluoropolymer: Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions [for seacoast and severe environments].
5. FEVE Fluoropolymer: Two-coat fluoropolymer finish containing 100 percent FEVE resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
6. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil for primer and 0.8 mil for topcoat.
7. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

D. Aluminum Roof Panels and Accessories:

1. 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 [for seacoast and severe environments].
2. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions [for seacoast and severe environments].
3. Mica Fluoropolymer: AAMA 2605. Two-coat fluoropolymer finish with suspended mica flakes 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 [for seacoast and severe environments].
4. Metallic Fluoropolymer: AAMA 2605. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions [for seacoast and severe environments].
5. FEVE Fluoropolymer: AAMA 2605. Two-coat fluoropolymer finish containing 100 percent FEVE resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
6. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil for primer and 0.8 mil for topcoat.
7. Exposed Anodized Finish:

    a. Clear Anodic Finish: AAMA 611, [AA-M12C22A41, Class I, 0.018 mm][AA-

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M12C22A31, Class II, 0.010 mm] or thicker.

b. Color Anodic Finish: AAMA 611, [AA-M12C22A42/A44, Class I, 0.018 mm][AA-M12C22A32/A34, Class II, 0.010 mm] or thicker.

E. Stainless Steel Roof Panels and Accessories:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finish: Grind and polish surfaces to produce uniform finish, free of cross scratches.

a. Run grain of directional finishes with long dimension of each piece.
b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
c. Directional Satin Finish: ASTM A480/A480M No. 4.

3. Bright, Cold-Rolled, Unpolished Finish: ASTM A480/A480M No. 2B.

F. Copper Roof Panels and Accessories:

1. Prepatination: Factory prepatinate in accordance with ASTM B882 to convert the copper surface to an inorganic crystalline structure with the appearance and durability of naturally formed patina.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of the Work.

1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.

a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before installation.

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

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3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages in accordance with ASTM C754 and metal roof panel manufacturer's written installation instructions.

3.3 INSTALLATION OF ROOF INSULATION

A. General: Install insulation concurrently with metal roof panel installation, in thickness indicated to cover entire surface, in accordance with manufacturer's written installation instructions.

1. Set vapor-retarder-faced units with vapor retarder toward warm side of construction unless otherwise indicated. Do not obstruct ventilation spaces except for firestopping.
2. Tape joints and ruptures in vapor retarder and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.

B. Blanket Roof Insulation: Comply with the following installation method:

1. Over-Framing Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal roof panels fastened to secondary framing.
2. Between-Purlin Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder-facing tabs up and over purlin, overlapping adjoining facing of next insulation course and maintaining continuity of retarder. Hold in place with bands and crossbands below insulation.

3.4 INSTALLATION OF COVER BOARD

A. Install cover board over insulation in accordance with manufacturer's written installation instructions. Install with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.

3.5 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated [below][on Drawings], wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. [Extend underlayment into gutter trough.] Roll laps with roller. Cover underlayment within 14 days.

1. Apply over the entire roof surface.
2. Apply over the roof area indicated below:

a. Roof perimeter for a distance up from eaves of

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[24 inches][36 inches]<Insert dimension> beyond interior wall line.

b. Valleys, from lowest point to highest point, for a distance on each side of [18 inches]<Insert dimension>. Overlap ends of sheets not less than 6 inches.
c. Rake edges for a distance of [18 inches]<Insert dimension>.
d. Hips and ridges for a distance on each side of [12 inches]<Insert dimension>.
e. Roof-to-wall intersections for a distance from wall of [18 inches]<Insert dimension>.
f. Around dormers, chimneys, skylights, and other penetrating elements for a distance from element of [18 inches]<Insert dimension>.

B. Felt Underlayment: Apply at locations indicated [below][on Drawings], in shingle fashion to shed water, and with lapped joints of not less than 2 inches.

1. Apply over the entire roof surface.
2. Apply on roof not covered by self-adhering sheet underlayment. Lap over edges of self-adhering sheet underlayment not less than 3 inches, in shingle fashion to shed water.

C. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

D. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.6 INSTALLATION OF STANDING-SEAM METAL ROOF PANELS

A. Install metal roof panels in accordance with manufacturer's written installation instructions and approved Shop Drawings in orientation, sizes, and locations indicated. Anchor metal roof panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal roof panels.
2. Flash and seal metal roof panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal roof panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal roof panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal roof panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Roof Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

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2. Aluminum Roof Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
3. Stainless Steel Roof Panels: Use stainless steel fasteners.
4. Copper Roof Panels: Use copper, stainless steel, or hardware-bronze fasteners.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal roof panel manufacturer.

D. Concealed Clip, Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.

E. Clipless, Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with screw fasteners at each lapped joint at location and spacing recommended by manufacturer.

F. Roof Panel Joints: Fasten panel joints to substrate in accordance with manufacturer's instructions.

1. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
2. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
3. Watertight Installation:

    a. Apply a continuous ribbon of sealant or tape to seal joints of metal roof panels, using sealant or tape as recommended in writing by manufacturer as needed to make panels watertight.
    b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
    c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

G. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.

H. Flashing and Trim: Comply with performance requirements and manufacturer's written

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installation instructions. Provide concealed fasteners where possible and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 ft. with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

I. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

J. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.

1. Provide elbows at base of downspouts to direct water away from building.
2. Connect downspouts to underground drainage system indicated.

K. Roof Curbs: Install curbs at locations indicated on Drawings. Install flashing around bases where they meet metal roof panels.

L. Pipe and Conduit Penetrations: Fasten and seal to metal roof panels as recommended by manufacturer.

3.7 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 ft. on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.8 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.

C. Additional tests and inspections, at Contractor's expense, are performed to determine

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compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.9 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113.16

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SECTION 074213.13 - FORMED METAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concealed-fastener, lap-seam metal wall panels.

B. Related Requirements:

1. Section 074293 "Soffit Panels" for metal panels used in horizontal soffit applications.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal panel assembly during and after installation.
8. Review of procedures for repair of metal panels damaged after installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.3 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

1. Exposed-fastener, lap-seam metal wall panels.

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2. Concealed-fastener, lap-seam metal wall panels.
3. Metal liner panels.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied finishes.

1. Include Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below:

1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For exposed-fastener, lap-seam metal wall panels, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels 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.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

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1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including rupturing, cracking, or puncturing.
    b. Deterioration of metals and other materials beyond normal weathering.

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

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

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1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

    a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
    b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
    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. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/240 of the span.

C. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft..

D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft..

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing 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 (Range): 120 deg F, ambient; 180 deg F, material surfaces.

F. Fire-Resistance Ratings: Comply with ASTM E119; 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.

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2.2 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

A. Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners [and factory-applied sealant] in side laps. Include accessories required for weathertight installation.

B. Flush-Profile, Concealed-Fastener Metal Wall Panels: Formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges; with flush joint between panels.

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

    a. ATAS International, Inc.
    b. CENTRIA, a Nucor Brand
    c. Englert, Inc.
    d. Pac-Clad, Petersen; a Carlisle Company

2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Nominal Thickness: 0.022 inch.
    b. Exterior Finish: Three-coat fluoropolymer.
    c. Color: As selected by Architect from manufacturer's full range.

3. Aluminum Sheet: Coil-coated sheet, ASTM B209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

    a. Thickness: 0.032 inch.
    b. Surface: Smooth, flat finish.
    c. Exterior Finish: Three-coat fluoropolymer.
    d. Color: As selected by Architect from manufacturer's full range.

4. Panel Coverage: 12 inches.
5. Panel Height: 1.0 inch.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel

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system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.4 FABRICATION

A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full

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length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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 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. Aluminum Panels and Accessories:

1. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions .

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.

    a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

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

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION OF METAL PANELS

A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping

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screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.

8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
2. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
3. Copper Panels: Use copper, stainless steel, or hardware-bronze fasteners.
4. Stainless Steel Panels: Use stainless steel fasteners.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
5. Flash and seal panels with weather closures at perimeter of all openings.

E. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

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G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration according to AAMA 501.2.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.

D. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.

E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

F. Prepare test and inspection reports.

3.5 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

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SECTION 075423 - THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermoplastic polyolefin (TPO) roofing system.
2. Venting base sheet
3. Vapor retarder.
4. Roof insulation.
5. Cover board.
6. Walkways.

B. Products Installed, but Not Furnished, under this Section:

1. Sound-absorbing insulation strips.

C. Related Requirements:

1. Section 053100 "Steel Decking" for roof deck panels and sound-absorbing insulation strips.
2. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
3. Section 061600 "Sheathing" for wood-based, structural-use roof deck panels.
4. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
5. Section 077100 "Roof Specialties" for premanufactured copings and roof edge fasciae, gravel stops, reglets, roof edge flashings, and counterflashings.
6. Section 077129 "Manufactured Roof Expansion Joints" for premanufactured roof expansion-joint assemblies.
7. Section 077200 "Roof Accessories" for manufactured roof curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
8. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
9. Section 221423 "Storm Drainage Piping Specialties" for roof drains.

1.2 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA's " Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.3 PREINSTALLATION MEETINGS

A. Preliminary Roofing Conference: Before starting roof deck construction, conduct

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conference [at Project site][by web conference]<Insert location>.

1. Meet with Owner, Architect, [Construction Manager,] Owner's insurer if applicable, testing and inspecting agency representative, roofing system Installer, roofing system manufacturer's representative, deck Installer, air barrier 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. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

B. Preinstallation Roofing Conference: Conduct conference [at Project site][by web conference]<Insert location>.

1. Meet with Owner, Architect, [Construction Manager,] Owner's insurer if applicable, testing and inspecting agency representative, roofing system Installer, roofing system manufacturer's representative, deck Installer, air barrier 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. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

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1.4 ACTION SUBMITTALS

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

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base and sheet flashings and membrane termination details.
3. Flashing details at penetrations.
4. Tapered insulation layout, thickness, and slopes.
5. Roof plan showing orientation of roof deck and orientation of roofing membrane, fastening spacings, and pattern for corner, perimeter, and field-of-roof locations.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Crickets, saddles, and tapered edge strips, including slopes.
8. Tie-in with adjoining wall system air barrier.

C. Samples for Verification: For the following products:

1. TPO Roofing Membrane Sheet: Of color required.
2. Base and Sheet Flashings: Of color required.
3. Walkways: Of color required.

D. Wind-Uplift-Resistance Submittal: For roofing system indicating compliance with wind-uplift performance requirements.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roofing membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of compliance with specified performance requirements.

2. Special Warranty Certificate: Signed by roofing membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Product Test Reports: For roofing membrane and insulation, tests performed by an independent qualified testing agency indicating compliance with specified requirements.

C. Research Reports: For components of roofing system, from [an agency acceptable to authorities having jurisdiction][ICC-ES]<Insert evaluation agency> showing compliance with specified performance requirements.

D. Field Test Reports:

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1. Concrete internal relative humidity test reports.
2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

E. Field Quality Control Reports: For specified tests and inspections.

F. Qualification Statements: For roofing system [Installer][manufacturer][and][testing agency].

G. Sample Warranties: For specified special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system.

B. Existing Warranty Documentation: Certified statement from existing roofing system manufacturer stating that existing roof warranty has not been affected by the Work performed under this Section.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is [ULSE listed][listed in FM Approvals' RoofNav][listed in SPRI's "Directory of Roof Assemblies"] for roofing system identical to that used for this Project.

B. Roofing System Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1. Certified Roofing System Installer: Entity that employs [a supervisor who is an NRCA ProCertified Roofing Foreman or installers who are NRCA ProCertified thermoplastic system installers][a supervisor who is an NRCA ProCertified Roofing Foreman][a supervisor who is an NRCA ProCertified Roofing Foreman and not less than 20 percent of installers who are NRCA ProCertified thermoplastic system installers].

C. Testing Agency Qualifications: An independent agency qualified to perform specified field tests [and is acceptable to authorities having jurisdiction].

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing system materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.

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1. Protect stored liquid material from direct sunlight.
2. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources.

1. Store in a dry location.
2. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing system materials, and place equipment in a manner to avoid permanent deflection of deck.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed in accordance with manufacturer's written installation instructions and warranty requirements.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty to include all components of roofing system, such as [substrate board,][vapor retarder,] roof insulation, fasteners, adhesives, [cover board,] roofing membrane, base flashing sheet, [ballast,][walkways,] and other components of roofing system.
2. Warranty Period: [10][15][20][30]<Insert number> years from date of Substantial Completion.

B. Roofing System Installer's Warranty: Submit roofing system Installer's warranty, on warranty form at end of this Section, signed by roofing system Installer, covering the Work of this Section, including all components of roofing system, such as [substrate board,][vapor retarder,] roof insulation, fasteners, adhesives, [cover board,] roofing membrane, base flashing sheet, [ballast,][walkways,] and other components of roofing system.

1. Warranty Period: [Two][Five]<Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain components for roofing system from [roofing membrane

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manufacturer][or][manufacturer approved by roofing membrane manufacturer].

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and flashings to withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing system and flashings to remain watertight.

1. Accelerated Weathering: Roofing membrane to withstand 2000 hours of exposure when tested in accordance with ASTM G152, ASTM G154, or ASTM G155.
2. Impact Resistance: Roofing membrane to resist impact damage when tested in accordance with ASTM D3746/D3746M, ASTM D4272/D4272M, or the Resistance to Foot Traffic Test in FM Approvals 4470.

B. Material Compatibility: Roofing system materials to be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.

C. Wind-Uplift Resistance: Design roofing system to resist the following wind-uplift pressures when tested in accordance with FM Approvals 4474, UL 580, or UL 1897:

1. Zone 1' (Roof Area Interior): <Insert lbf/sq. ft.>.
2. Zone 1 (Roof Area Field): <Insert lbf/sq. ft.>.
3. Zone 2 (Roof Area Perimeter): <Insert lbf/sq. ft.>.

    a. Location: From roof edge to <Insert dimension> inside roof edge.

4. Zone 3 (Roof Area Corners): <Insert lbf/sq. ft.>.

    a. Location: <Insert dimension> in each direction from each building corner.

D. FM Approvals' RoofNav Listing: Roofing membrane, base flashings, and component materials to comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system and are listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: [Class 1A-60][Class 1A-75][Class 1A-90][Class 1A-105][Class 1A-120]<Insert class>.
2. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34 [MH][SH][VSH].

E. SPRI's "Directory of Roof Assemblies" Listing: Roofing membrane, base flashings, and component materials to comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system and are listed in SPRI's "Directory of Roof Assemblies" for roof assembly identical for that specified for this Project.

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1. Wind-Uplift Load Capacity: [60 psf][75 psf][90 psf][105 psf][120 psf]<Insert capacity>.

F. Cool Roof Rating Council (CRRC): Roofing system to be listed by the CRRC for low-slope roof products.

G. Energy Performance: Roofing system to have an initial solar reflectance index (SRI) of not less than [0.70]<Insert value> and an emissivity of not less than [0.75]<Insert value> when tested in accordance with CRRC S100.

H. Exterior Fire-Test Exposure: [Class A][Class B][Class C]; for application and roof slopes indicated; when tested by a qualified testing agency in accordance with ASTM E108 or UL 790.

1. Identify products with appropriate markings of applicable testing agency.

I. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated.

1. Identify products with appropriate markings of applicable testing agency.

2.3 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING SYSTEM

A. TPO Roofing Membrane Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced, TPO sheet.

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

a. Carlisle SynTec Systems; a Carlisle Company
b. GAF
c. Johns Manville; a Berkshire Hathaway company
d. Tremco, Inc.

2. Basis-of-Design Product: Subject to compliance with requirements, provide <Insert manufacturer's name; product name or designation> or comparable product by one of the following:

a. Carlisle SynTec Systems; a Carlisle Company
b. GAF
c. Johns Manville; a Berkshire Hathaway company
d. Tremco, Inc.

3. Membrane Option: Manufacturer's standard.
4. Thickness: 60 mils, nominal.
5. Exposed Face Color: White.

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2.4 ACCESSORY ROOFING SYSTEM MATERIALS

A. General: Accessory materials as recommended in writing by roofing membrane manufacturer for intended use and compatible with other roofing system components.

B. Base and Sheet Flashings: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as roofing membrane.

C. Prefabricated Pipe Flashings: As recommended in writing by roofing membrane manufacturer.

D. Roof Vents: As recommended in writing by roofing membrane manufacturer.

1. Size: Not less than 4-inch diameter.

E. Bonding Adhesive: Roofing membrane manufacturer's standard [, water based].

F. Slip Sheet: Manufacturer's standard, of thickness required for application.

G. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

H. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, prepunched.

I. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing system components to substrate; tested for required pullout strength, and acceptable to roofing membrane manufacturer.

J. Safety Accessories: Roofing membrane manufacturer's standard yellow warning tape for designating safety perimeters and rooftop hazards.

K. Miscellaneous Accessories: As recommended in writing by roofing membrane manufacturer.

2.5 VENTING BASE SHEET

A. Venting Base Sheet : ASTM D4897/D4897M, Type II; nonperforated, asphalt impregnated, fiberglass reinforced, with mineral granular patterned surfacing on bottom surface.

2.6 SUBSTRATE BOARD

A. Substrate Board Accessories:

1. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

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2. Bonding Adhesive: Manufacturer's standard, designed for adhering substrate board to roof deck.

2.7 VAPOR RETARDER

A. Laminated Sheet Vapor Retarder: Two layers; fire-retardant polyethylene laminate; reinforced with cord grid.

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

a. Reef Industries, Inc.

2. Permeance Rating: Not more than 0.062 perm when tested in accordance with ASTM E96/E96M.
3. Flame-Spread Index: Not more than 5 when tested in accordance with ASTM E84.
4. Smoke-Developed Index: Not more than 35 when tested in accordance with ASTM E84.
5. Tape: Pressure-sensitive tape of type recommended by vapor retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.8 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured [or approved] by roofing membrane manufacturer, approved for use in [FM Approvals' RoofNav][SPRI's "Directory of Roof Assemblies"] listed roof assemblies.

B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, with factory-applied facing board on both major surfaces, as indicated below.

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

a. Carlisle SynTec Systems; a Carlisle Company
b. GAF
c. Johns Manville; a Berkshire Hathaway company

2. Facer: [Class 1 felt facer][Class 2 coated glass-fiber facer][Class 3 uncoated glass-fiber facer].
3. Compressive Strength: [Grade 2, 20 psi][Grade 3, 25 psi].
4. Size: 48 by 96 inches.
5. Thickness:

a. Base Layer: [1-1/2 inches]<Insert thickness>.
b. Upper Layer: <Insert thickness>.

C. Tapered Insulation : Provide factory-tapered insulation boards.

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1. Material: [Match roof insulation]<Insert material>.
2. Minimum Thickness: 1/4 inch.
3. Slope:

    a. Roof Field: [1/4 inch per foot]<Insert slope> unless otherwise indicated on Drawings.
    b. Saddles and Crickets: [1/2 inch per foot]<Insert slope> unless otherwise indicated on Drawings.

D. Roof Insulation Accessories: As recommended in writing by insulation manufacturer for intended use and compatibility with other roofing system components.

1. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation [to substrate][and] to another insulation layer as follows:

    a. Modified asphaltic, asbestos-free, cold-applied adhesive.
    b. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
    c. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

2. Insulation Fasteners: Insulation manufacturer's standard factory-coated steel fasteners with metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
3. Induction-Welding Plates: Minimum 3-inch diameter with recessed center, 0.034-inch thick, aluminum-zinc-alloy-coated steel plates, factory coated with adhesive formulated for roof membrane, with corresponding corrosion-resistant fasteners [and thermal isolation spacers below plates].

2.9 COVER BOARD

A. General: Cover board as recommended in writing by roofing membrane manufacturer for intended use and compatible with other roofing system components.

B. Protection Mat : Woven or nonwoven polypropylene, polyolefin, or polyester fabric; water permeable and resistant to UV degradation; type and weight as recommended in writing by roofing system manufacturer for application.

2.10 WALKWAYS

A. Flexible Walkways : Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16 inch thick and acceptable to roofing system manufacturer.

1. Size: Approximately 36 by 60 inches.
2. Color: Contrasting with roofing membrane.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with roofing system Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
4. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch out of plane relative to adjoining deck.
5. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
6. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than [75]<Insert number> percent, or as recommended by roofing system manufacturer, when tested in accordance with ASTM F2170.

    a. Test Frequency: One test probe per each [1000 sq. ft.]<Insert area>, or portion thereof, of roof deck, with not less than three tests probes.
    b. Submit test reports within 24 hours after performing tests.

7. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
8. Verify that joints in precast concrete roof decks have been grouted flush with top of concrete.
9. Verify that minimum curing period recommended by roofing system manufacturer for lightweight insulating concrete roof decks has passed.
10. Verify any damaged sections of cementitious wood-fiber decks have been repaired or replaced.
11. Verify adjacent cementitious wood-fiber panels are vertically aligned to within 1/8 inch at top surface.

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

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation in accordance with roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

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C. Prime surface of concrete deck with primer in accordance with roofing system manufacturer's written installation instructions and allow primer to dry.

D. Perform fastener-pullout tests in accordance with roofing system manufacturer's written instructions.

1. Submit test result within 24 hours after performing tests.

a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

E. Sound-Absorbing Insulation Strips: Install sound-absorbing insulation strips in ribs of acoustical steel roof deck in accordance with roof deck manufacturer's written instructions.

3.3 INSTALLATION OF THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING SYSTEM

A. Install roofing system materials and components in accordance with roofing system manufacturer's written installation instructions, [FM Approvals' RoofNav][SPRI's "Directory of Roof Assemblies"] listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.

C. Install roofing membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition [and to not void warranty for existing roofing system].

D. Coordinate installation and transition of roofing system component serving as an air barrier with wall system air barrier specified under [Section 072713 "Modified Bituminous Sheet Air Barriers."][Section 072715 "Nonbituminous Self-Adhering Sheet Air Barriers."][Section 072726 "Fluid-Applied Membrane Air Barriers."]

E. Substrate-Joint Penetrations: Prevent adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.4 INSTALLATION OF VENTING BASE SHEET

A. Install base sheet over lightweight insulating concrete roof deck in accordance with manufacturer's written instructions.

3.5 INSTALLATION OF VAPOR RETARDER

A. Install vapor retarder in a single layer over roof area in accordance with manufacturer's

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written installation instructions, side and end lapping each sheet a minimum of 2 and 6 inches, respectively.

1. Extend vertically up parapet walls and projections to a minimum height equal to height of insulation and cover board.
2. Continuously seal side and end laps with tape.

B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.6 INSTALLATION OF ROOF INSULATION

A. Coordinate installation of roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and insulation manufacturer's written installation instructions. Install minimum of two layers of insulation under area of roofing to achieve required thickness.

C. Install each layer of insulation with [joints staggered not less than 24 inches in adjacent rows][end joints staggered not less than 12 inches in adjacent rows] and offset not less than 12 inches from previous layer.

1. Trim insulation neatly to fit around penetrations and projections, and to fit tightly to intersecting sloping roof decks.
2. Make joints between adjacent insulation boards not more than 1/4 inch in width.
3. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches.
4. Trim insulation, so that water flow is unrestricted.
5. Fill gaps exceeding 1/4 inch with insulation.
6. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
7. Secure insulation in accordance with [FM Approvals' RoofNav for specified Windstorm Resistance Classification][SPRI's "Directory of Roof Assemblies" for specified wind-uplift load capacity].
8. Secure insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
9. Place [thermal spacers and] plates on insulation in required fastening patterns [to achieve FM rating] and secure in accordance with manufacturer's instructions.

    a. Install plates and fasteners tight and flat to substrate with no dimpling, and with fastener extending 1 inch minimum into roof deck; do not overdrive fasteners.

10. Loosely lay each layer of insulation over substrate.

3.7 INSTALLATION OF COVER BOARD

A. Install cover board over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches

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in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

    a. Trim cover board so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Adhere cover board to substrate in accordance with [FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification][SPRI's "Directory of Roof Assemblies" listed roof assembly requirements for specified wind-uplift load capacity] and FM Global Property Loss Prevention Data Sheet 1-29.

B. Install slip sheet over cover board and beneath roofing membrane.

C. Place plates on cover board in required fastening patterns [to achieve FM rating] and secure in accordance with roofing system manufacturer's written installation instructions.

1. Install plates and fasteners tight and flat to substrate with no dimpling, and with fastener extending 1 inch minimum into roof deck; do not overdrive fasteners.

3.8 INSTALLATION OF TPO ROOFING MEMBRANE SHEET

A. Install roofing membrane over roof area for [adhered][self-adhered][mechanically attached][loose-laid, ballasted] application method in accordance with roofing system manufacturer's written installation instructions.

B. Unroll roofing membrane and allow it to relax before installing.

C. Start installation in presence of roofing system manufacturer's technical personnel [and Owner's testing and inspection agency].

D. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps. Apply roofing membrane with side laps shingled with slope of roof deck where possible.

E. Adhered Application: Apply bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allow to partially dry before installing roofing membrane. Do not apply to splice area of roofing membrane.

1. In addition to adhering, mechanically fasten roofing membrane securely at terminations, penetrations, and perimeter of roof area.

F. Mechanically Attached Application: Secure roofing membrane over area using metal battens to receive roofing in accordance with roofing system manufacturer's written installation instructions.

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1. Mechanically fasten or adhere roof membrane securely at terminations, penetrations, and perimeter of roofing.
2. Induction-Weld Attachment: Secure roofing membrane to plates creating 100 percent bond between underside of membrane and top of plates; a partial bond is unacceptable. Test welds to verify adhesion of roofing membrane to top of plates in accordance with manufacturer's instructions.

G. Ballast: For loose-laid, ballasted applications, comply with requirements in ANSI/SPRI RP-4 for [System 1][System 2][System 3].

1. [Mechanically fasten][Adhere] roofing membrane at perimeter, corners, and transitions in accordance with requirements in ANSI/SPRI RP-4.
2. At corners and perimeters, omit aggregate ballast leaving roofing membrane exposed.
3. At corners and perimeters, adhere a second layer of roofing membrane.
4. Install protection mat over roofing membrane, overlapping a minimum of 6 inches. Install an additional protection mat layer at projections, pipes, vents, and drains, overlapping a minimum of 12 inches.
5. Roof Paver Ballast: Install [lightweight][heavyweight] roof paver ballast in accordance with manufacturer's written instructions.
6. Roof Paver and Aggregate Ballast: Install heavyweight roof pavers in accordance with manufacturer's written instructions on roof corners and perimeter.

    a. Install Size 4 aggregate ballast elsewhere on roof membrane at a minimum rate of 10 lb/sq. ft..
    b. Install Size 2 aggregate ballast elsewhere on roof membrane at a minimum rate of 13 lb/sq. ft..

H. Seams and End Laps: Clean seam areas, overlap membrane, and hot-air-weld side seams and end laps of roofing membrane and sheet flashings to ensure a watertight installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane and sheet flashings.
2. Verify field strength of seams a minimum of [twice]<Insert number of daily seam tests> daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing membrane that do not comply with requirements.

I. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing membrane in place with clamping ring.

J. Safety Accessories: Install safety warning tape per manufacturer's written instructions for designating safety perimeters and rooftop hazards as indicated on Drawings.

3.9 INSTALLATION OF BASE AND SHEET FLASHINGS

A. General: Install and adhere base and sheet flashing and preformed flashing accessories to substrates in accordance with roofing system manufacturer's written installation instructions.

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B. Apply bonding adhesive to substrate and underside of flashings at required rate and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners.

D. Clean seam areas, overlap, and firmly roll flashings into the adhesive. Hot-air-weld side seams and end laps to ensure a watertight installation.

E. Terminate and seal top of flashings and mechanically anchor to substrate through termination bars.

3.10 INSTALLATION OF WALKWAYS

A. Flexible Walkways: Install walkway products in accordance with manufacturer's written installation instructions.

1. Install flexible walkways at the following locations:

a. Perimeter of each rooftop unit.
b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
d. Top and bottom of each roof access ladder.
e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
f. Locations indicated on Drawings.
g. As required by roofing membrane manufacturer's warranty requirements.

2. Provide 6-inch clearance between adjoining pads.
3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive in accordance with roofing system manufacturer's written instructions.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: [Owner will engage][Engage] a qualified testing agency to perform tests and inspect substrate conditions, surface preparation, and installation of roofing membrane, flashings, protection, and drainage components, and to furnish reports to Architect.

B. Tests and Inspections:

1. ELD Testing: Testing agency surveys entire roof area and flashings to locate discontinuities in the roofing membrane using ELD in accordance with ASTM D7877 and ASTM D8231.

a. After testing, repair areas of discontinuities, repeat tests, and make further repairs until roofing and flashing installations are contiguous.

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1) Cost of retesting is Contractor's responsibility.

b. Testing agency to prepare survey report indicating locations of initial discontinuities, if any.

2. Flood Testing: Flood test each roof area for leaks, in accordance with recommendations in ASTM D5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

a. Flood to an average depth of [2-1/2 inches]<Insert depth> with a minimum depth of [1 inch]<Insert depth> and not exceeding a depth of [4 inches]<Insert depth>. Maintain 2 inches of clearance from top of base flashing.
b. Flood each area for [24][48][72] hours.
c. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.

1) Cost of retesting is Contractor's responsibility.

d. Testing agency to prepare survey report indicating locations of initial leaks, if any, and final survey report.

3. Infrared Thermography Testing: Testing agency surveys entire roof area using infrared color thermography in accordance with ASTM C1153. Perform tests before overlying construction is placed.

a. After infrared scan, locate specific areas of leaks by electrical capacitance/impedance testing or nuclear hydrogen detection testing.
b. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.

1) Cost of retesting is Contractor's responsibility.

c. Testing agency to prepare survey report of initial scan indicating locations of entrapped moisture, if any.

4. Electrical Capacitance/Impedance Testing: Testing agency surveys entire roof area for entrapped water within roof assembly in accordance with ASTM D7954/D7954M. Perform tests before overlying construction is placed.

a. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.

1) Cost of retesting is Contractor's responsibility.

b. Testing agency to prepare survey report indicating locations of entrapped moisture, if any.

5. Nuclear Hydrogen Detection Testing: Testing agency surveys entire roof area for entrapped water within roof assembly in accordance with ANSI/SPRI/RCI NT-1.

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Perform tests before overlying construction is placed.

a. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.

1) Cost of retesting is Contractor's responsibility.

b. Testing agency to prepare survey report indicating locations of entrapped moisture, if any.

C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

1. Notify Architect [and Owner] 48 hours in advance of date and time of inspection.

D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

1. Roofing system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.12 CLEANING

A. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.13 PROTECTION

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

3.14 ROOFING SYSTEM INSTALLER'S WARRANTY

A. WHEREAS _____ of _____, herein called the "Roofing System Installer," has

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performed roofing and associated Work on the following Project:

1. Owner: <Insert name of Owner>.
2. Owner Address: <Insert address>.
3. Building Name/Type: <Insert information>.
4. Building Address: <Insert address>.
5. Area of Work: <Insert information>.
6. Warranty Period: [Two][Five]<Insert number> years from date of Substantial Completion.
7. Date of Substantial Completion: _____.

B. AND WHEREAS Roofing System Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said Work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing System Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period, Roofing System Installer will, at Roofing System Installer's own cost and expense, make or cause to be made such repairs to or replacements of said Work as are necessary to correct faulty and defective work and as are necessary to maintain said Work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to Work and other parts of the building, and to building contents, caused by:

    a. lightning;
    b. peak gust wind speed exceeding <Insert mph>;
    c. fire;
    d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the Work;
    f. vapor condensation on bottom of roofing; and
    g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When Work has been damaged by any of foregoing causes, Warranty will be null and void until such damage has been repaired by Roofing System Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing System Installer is responsible for damage to Work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of Work.
4. During Warranty Period, if Owner allows alteration of Work by anyone other than Roofing System Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty will become null and void on date of said

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alterations, but only to the extent said alterations affect Work covered by this Warranty. If Owner engages Roofing System Installer to perform said alterations, Warranty will not become null and void unless Roofing System Installer, before starting said Work, will have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate Work, thereby reasonably justifying a limitation or termination of this Warranty.

5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty will become null and void on date of said change, but only to the extent said change affects Work covered by this Warranty.
6. Owner will promptly notify Roofing System Installer of observed, known, or suspected leaks, defects, or deterioration and afford reasonable opportunity for Roofing System Installer to inspect Work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing System Installer on said Work and will not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty will not operate to relieve Roofing System Installer of responsibility for performance of original Work in accordance with requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION 075423

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SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Manufactured units for the following applications:

1. Copings.
2. Roof-edge specialties.
3. Roof-edge drainage systems.
4. Reglets and counterflashings.
5. Underlayment.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing embedded reglets.
2. Section 042000 "Unit Masonry" for installing embedded reglets and for masonry through-wall flashing with receiver for counterflashing.
3. Section 055000 "Metal Fabrications" for downspout guards and downspout boots.
4. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
5. Section <Insert Section number> " <Insert Section title> " for air barrier and compatibility with and transitions to underlayment for roof specialties.
6. Section <Insert Section number> " <Insert Section title> " for roof-edge drainage-system components provided by metal-roof-panel manufacturer.
7. Section 076200 "Sheet Metal Flashing and Trim" for custom- and site-fabricated, sheet metal flashing and trim.
8. Section 077129 "Manufactured Roof Expansion Joints" for manufactured roof expansion-joint cover assemblies.
9. Section 077200 "Roof Accessories" for manufactured roof curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
10. Section 077253 "Snow Guards" for prefabricated devices designed to hold snow on the roof surface, allowing it to melt and drain off slowly.
11. Section 079200 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.
12. Section 099113 "Exterior Painting" for field painting of roof specialties.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]<Insert location>.

1. Meet with Owner, Architect, Owner's insurer if applicable, roofing-system testing and inspecting agency representative, roofing Installer, roofing-system manufacturer's representative, Installer, structural-support Installer, and installers whose work interfaces with or affects roof specialties, including installers of roofing materials and accessories.

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2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of roof specialty.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof specialties.

1. Plans, expansion-joint locations, keyed details, and attachments to other work. Distinguish between factory pre manufactured- and field-assembled installation.
2. Details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
4. Details of termination points and assemblies, including fixed points.
5. Details of special conditions.

C. Samples: For each type of roof specialty and for each color and texture specified.

D. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.

E. Samples for Verification:

1. Include Samples of each type of roof specialty to verify finish and color selection, in manufacturer's standard sizes.
2. Include [copings][roof-edge specialties][roof-edge drainage systems][reglets and counterflashings] made from 12-inch lengths of full-size components in specified material, and including fasteners, cover joints, accessories, and attachments.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of roof specialty [copings][and][roof-edge flashings] that is [ANSI/SPRI/FM 4435/ES-1 tested][and][FM Approvals approved].

B. Product Test Reports: For [copings][and][roof-edge flashings], for tests performed by a qualified testing agency.

C. Research Reports: For [copings][and][roof-edge flashings], from [an agency acceptable to authorities having jurisdiction][ICC-ES]<Insert evaluation agency> showing compliance with ANSI/SPRI/FM 4435/ES-1.

D. Qualification Statements: For manufacturer.

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E. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roof specialties.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products that are [FM Approvals listed for specified class][and][ANSI/SPRI/FM 4435/ES-1 tested to specified design pressure].

1.7 MOCKUPS

A. 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 edge as indicated on Drawings.
2. Build mockup of typical roof edge as part of "Integrated Exterior Mockup" specified in [Section 014000 "Quality Requirements."]<Insert Section number and title.>
3. Build mockup of typical roof edge, including [fascia][gutter][and][downspout]<Insert item>, approximately [10 ft.]<Insert dimension> long, including supporting construction, seams, attachments, [underlayment,] and accessories.
4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.

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1.10 COORDINATION

A. Coordinate roof specialties with roofing system, exterior wall system, air barrier, flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, weathertight, secure, and noncorrosive installation.

1. Performance Coordination: Coordinate with the Work of roofing and exterior wall Sections to ensure that roof specialties provided under the Work of this Section meet or exceed specified roofing and exterior wall design performance requirements.

B. Confirm and coordinate compatibility of materials and comply with warranty requirements of roofing system manufacturer.

C. Coordinate roof specialties layout and seams with sizes and locations of joints and seams in adjacent materials.

1.11 WARRANTY

A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section <Insert Section number> " <Insert Section title>."

B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finishes or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: [20][10]<Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain roof specialties from single manufacturer providing roofing-system warranty specified in Section 075423 " Thermoplastic-Polyolefin (TPO) Roofing."

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2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Roof specialties to withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert value> percent.

C. FM Approvals' Listing: Manufacture and install [copings][roof-edge specialties] that are listed in FM Approvals' "Approval Guide" and approved for windstorm classification, [Class 1-60][Class 1-75][Class 1-90][Class 1-105][Class 1-120]<Insert class>. Identify materials with FM Approvals' markings.

D. SPRI Wind Design Standard: Manufacture and install [copings][roof-edge specialties] tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressures:

1. Design Pressure: [As indicated on Drawings]<Insert design pressure>.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. 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]<Insert temperature change>.

2.3 COPINGS

A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding [12 ft.]<Insert dimension>, concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.

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

a. ATAS International, Inc.
b. Englert, Inc.
c. Merchant & Evans Inc.

2. Metallic-Coated Steel Coping Caps: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, nominal thickness as required to meet performance requirements.

a. Surface: Smooth, flat finish.
b. Finish: Three-coat fluoropolymer.

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

3. Formed Aluminum Coping Caps: Aluminum sheet, thickness as required to meet performance requirements.

   a. Surface: Smooth, flat finish.
   b. Finish: Three-coat fluoropolymer.
   c. Color: As selected by Architect from manufacturer's full range.

4. Extruded-Aluminum Coping Caps: Extruded aluminum, thickness as required to meet performance requirements.

   a. Finish: Three-coat fluoropolymer.
   b. Color: As selected by Architect from manufacturer's full range.

5. Formed Stainless Steel Coping Caps: Stainless steel sheet, nominal thickness as required to meet performance requirements.

   a. Finish: ASTM A480/A480M No. 2B (bright, cold rolled).

6. Corners: Factory mitered and mechanically clinched and sealed watertight.
7. Special Fabrications: [Radiused sections][Arched sections][Bullnose-face leg][Two-way sloped coping cap]<Insert description>.
8. Coping-Cap Attachment Method: face leg hooked to continuous cleat with back leg fastener exposed, fabricated from coping-cap material.

   a. Snap-on Coping Anchor Plates: Concealed, galvanized-steel sheet, 12 inches wide, with integral cleats.
   b. Face-Leg Cleats: Concealed, continuous galvanized-steel sheet.

2.4 ROOF-EDGE SPECIALTIES

A. Canted Roof-Edge Fascia and Gravel Stop: Manufactured, two-piece, roof-edge fascia consisting of compression-clamped metal fascia cover in section lengths not exceeding [12 ft.]<Insert dimension> and a continuous formed galvanized-steel sheet cant, 0.028 inch thick, minimum, with extended vertical leg terminating in a drip-edge cleat. Provide matching corner units.

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

      a. ATAS International, Inc.
      b. Englert, Inc.
      c. Merchant & Evans Inc.

   2. Metallic-Coated Steel Fascia Covers: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, nominal thickness as required to meet performance requirements.

      a. Surface: Smooth, flat finish.

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b. Finish: Three-coat fluoropolymer.
c. Color: As selected by Architect from manufacturer's full range.

3. Formed Aluminum Fascia Covers: Aluminum sheet, thickness as required to meet performance requirements.

   a. Surface: Smooth, flat finish.
   b. Finish: Three-coat fluoropolymer.
   c. Color: As selected by Architect from manufacturer's full range.

4. Extruded-Aluminum Fascia Covers: Extruded aluminum, thickness as required to meet performance requirements.

   a. Finish: Three-coat fluoropolymer.
   b. Color: As selected by Architect from manufacturer's full range.

5. Corners: Factory mitered and mechanically clinched and sealed watertight.
6. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
7. Special Fabrications: [Radiused sections][Arched sections][Bullnose fascia cover][Cornice fascia cover][Cove fascia cover]<Insert description>.
8. Fascia Accessories: [Fascia extenders with continuous hold-down cleats][Wall cap][Soffit trim][Overflow scuppers][Overflow scuppers with perforated screens][Spillout scuppers][Downspout scuppers with integral conductor head and downspout adapters][Downspout scuppers with integral conductor head and downspout adapters and perforated screens]<Insert description>.

2.5 REGLETS AND COUNTERFLASHINGS

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. ATAS International, Inc.

B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:

   1. Metallic-Coated Steel Sheet: Nominal 0.028-inch thickness.
   2. Corners: Factory mitered and mechanically clinched and sealed watertight.
   3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
   4. Stucco Type, Embedded: Provide reglets with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
   5. Concrete Type, Embedded: 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.
   6. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.
   7. Multiuse Type, Embedded: For multiuse embedment in masonry mortar joints.

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C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches and in lengths not exceeding [12 ft.]<Insert dimension> designed to snap into [reglets][or][through-wall-flashing receiver] and compress against base flashings with joints lapped, from the following exposed metal:

1. Metallic-Coated Steel Sheet: Nominal 0.028-inch thickness.

D. Accessories:

1. 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 reglet is provided separate from metal counterflashing.
2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

E. Finishes:

1. Metallic-Coated Steel: Three-coat fluoropolymer.

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

2. Aluminum: Three-coat fluoropolymer.

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

2.6 SHEET METAL MATERIALS

A. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with minimum ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with minimum ASTM A792/A792M, Class AZ50 coating designation; structural quality. [Mill phosphatized for field painting where indicated].

1. Mill-Phosphatized Finish: Manufacturer's standard for field painting.
2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil.
3. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A755/A755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer Finish: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight in color coat.

4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

B. Aluminum Sheet: ASTM B209/B209M, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.

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1. Mill Finish: As manufactured.
2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil.
3. Clear Anodic Finish: AAMA 611, [AA-M12C22A41, Class I, 0.018 mm][AA-M12C22A31, Class II, 0.010 mm] or thicker.
4. Color Anodic Finish: AAMA 611, [AA-M12C22A42/A44, Class I, 0.018 mm][AA-M12C22A32/A34, Class II, 0.010 mm] or thicker.
5. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A755/A755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

    a. Two-Coat Fluoropolymer Finish: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight in color coat.

6. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

C. Aluminum Extrusions and Tubes: ASTM B221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise, mill finished.

2.7 UNDERLAYMENT

A. Self-Adhering, High-Temperature Sheet Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum 30 mils thick, specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F; ASTM D1970/D1970M.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F or lower; ASTM D1970/D1970M.
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ATAS International, Inc.
    b. Henry; a Carlisle Company

B. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

C. Slip Sheet: Rosin-sized building paper, 3-lb/100 sq. ft. minimum.

2.8 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

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B. Fasteners: Roof specialty manufacturer's recommended fasteners, designed to meet performance requirements, suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

1. Fasteners for Metallic-Coated Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel in accordance with ASTM A153/A153M or ASTM F2329/F2329M.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
4. Fasteners for Copper Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.
5. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.

C. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

D. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.

F. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

G. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

2.9 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: 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.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.

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

3.2 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering, High-Temperature Sheet Underlayment:

1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

B. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lap joints not less than 2 inches.

C. Slip Sheet: Install slip sheet, wrinkle free, [over underlayment][directly on substrate]<Insert requirement> before installing sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lapp joints not less than 4 inches.

3.3 INSTALLATION, GENERAL

A. Install roof specialties in accordance with manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-

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canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer's written installation instructions.

1. Coat concealed side of uncoated aluminum roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of [12 ft.]<Insert dimension> with no joints within [18 inches]<Insert dimension> of corners or intersections unless otherwise indicated on Drawings.
2. 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.

D. Fastener Sizes: Use fasteners of 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][substrate not less than recommended in writing by fastener manufacturer to achieve maximum pull-out resistance]<Insert size requirement>.

E. Seal concealed joints with butyl sealant as required by roof specialty manufacturer.

F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.4 INSTALLATION OF COPINGS

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

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1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's required spacing that meets performance requirements.
2. Interlock face-leg drip edge into continuous cleat anchored to substrate at manufacturer's required spacing that meets performance requirements. Anchor back leg of coping with screw fasteners and elastomeric washers at manufacturer's required spacing that meets performance requirements.

3.5 INSTALLATION OF ROOF-EDGE SPECIALTIES

A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

3.6 INSTALLATION OF REGLETS AND COUNTERFLASHINGS

A. Coordinate installation of reglets and counterflashings with installation of base flashings.

B. Embedded Reglets: See [Section 033000 "Cast-in-Place Concrete"][and][Section 042000 "Unit Masonry"] for installation of reglets.

C. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches over top edge of base flashings.

D. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches and bed with butyl sealant. Fit counterflashings tightly to base flashings.

3.7 CLEANING AND PROTECTION

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing in accordance with ASTM A780/A780M.

B. Touch up factory-primed surfaces with compatible primer ready for field painting in accordance with Section 099113 "Exterior Painting."

C. Clean and neutralize flux materials. Clean off excess solder and sealants.

D. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

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E. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 077100

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SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Manufactured units for the following applications:

1. Roof curbs.
2. Equipment supports.
3. Roof hatches.
4. Heat and smoke vents.
5. Gravity ventilators.
6. Pipe and duct supports.
7. Pipe portals.
8. Preformed flashing sleeves.
9. Roof walkways.
10. Underlayment.
11. Miscellaneous materials.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
2. Section 061000 "Rough Carpentry" for roof cants, nailers, blocking, and other pressure-preservative-treated wood.
3. Section 077100 "Roof Specialties" for manufactured copings, roof-edge specialties, roof-edge drainage systems, reglets, and counterflashing.
4. Section 077253 "Snow Guards" for prefabricated devices designed to hold snow on the roof surface, allowing it to melt and drain off slowly.
5. Section 079200 "Joint Sealants" for field-applied sealants between roof accessories and adjacent materials.
6. Section 099113 "Exterior Painting" for field painting of roof accessories.
7. Section 099114 "Exterior Painting (MPI Standards)" for field painting of roof accessories.

1.2 ACTION SUBMITTALS

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

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings:

1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and

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field-assembled work.

C. Samples for Initial Selection: For each type of roof accessory indicated with factory-applied color finishes.

D. Samples for Verification: Include Samples of each type of roof accessory to verify finish and color selection, in manufacturer's standard sizes.

E. Delegated Design Submittals: For roof curbs [, roof walkways,][and equipment supports] 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. Detail mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordinating requirements with roof membrane system.
2. Wind-Restraint Details: Detail fabrication and attachment of wind restraints. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:

1. Size and location of roof accessories specified in this Section.
2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items, including mechanical and electrical equipment, ductwork, piping, and conduit.
4. Required clearances.

B. Qualification Statements: For [manufacturer][fabricator][Installer][specialist][testing agency][manufacturer's technical representative][factory-authorized service representative]<Insert entity or specialist>.

C. Delegated Design Engineer Qualifications: For roof curbs [, roof walkways][, and][equipment supports].

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For [roof hatches][, heat and smoke vents][and gravity ventilators].

1.5 QUALITY ASSURANCE

A. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in [state]<Insert jurisdiction> where Project is located and who is experienced in providing engineering services of the type indicated.

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1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof accessories in contact with other materials that might cause staining, denting, or other surface damage. Store roof accessories in accordance with manufacturer's instructions.

B. Store materials off ground in dry location and in accordance with manufacturer's instructions in well-ventilated area.

C. Store and protect roof accessories from nicks, scratches, and blemishes.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify profiles and tolerances of roof-accessory substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.8 COORDINATION

A. Coordinate layout and installation of roof accessories with [roofing membrane and base flashing and] interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories to withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design roof curbs [, roof walkways,][and equipment supports] to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Wind-Restraint Performance: [As indicated on Drawings]<Insert requirements>.

2.2 ROOF CURBS

A. Roof Curb: Internally reinforced roof-curb unit capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements.

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1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. [AES Industries, Inc]
    b. [AES Sunoptics; Acuity Brands International, Inc.]
    c. [Air Balance; MESTEK, Inc.]
    d. [ATAS International, Inc.]
    e. [Conn-Fab Sales, Inc]
    f. [Curbs Plus, Inc]
    g. [Custom Solution Roof and Metal Products, a division of Colony Heating]
    h. [Greenheck Fan Corporation]
    i. [KCC Manufacturing]
    j. [Lloyd Industries, Inc.]
    k. [LMCurbs]
    l. [Louvers & Dampers, Inc.; Mestek, Inc.]
    m. [Metallic Products Corporation]
    n. [Pate Company (The)]
    o. [Plenums of Florida Incorporated]
    p. [RCS Fabrications Inc.]
    q. [Roof Products and Systems (RPS); Duravent Group]
    r. [Roof Products, Inc.]
    s. [Thybar Corporation]
    t. [Vent Products Co., Inc]
    u. <Insert manufacturer's name>

2. Corner Joints: Welded [or mechanically fastened and sealed].
3. Curb Sides: [Straight][Integral metal cant][Stepped integral metal cant to raise the thickness of roof insulation] and integrally formed deck-mounting flange at perimeter bottom.
4. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
5. Supported Load Capacity: [Coordinate load capacity with information on Shop Drawings of equipment to be supported]<Insert load requirements>.
6. Steel: [Zinc-coated (galvanized)][Aluminum-zinc alloy-coated] steel sheet, [0.052 inch][0.064 inch][0.079 inch]<Insert dimension> thick.

    a. Finish: [Mill phosphatized][Factory prime coating][Powder coat]<Insert finish>.
    b. Color: [As indicated by manufacturer's designations][Match Architect's sample][As selected by Architect from manufacturer's full range]<Insert color>.

7. Aluminum: [0.090 inch][0.125 inch]<Insert dimension> thick sheet.

    a. Finish: [Mill][Factory prime coating][Clear anodic][Color anodic][Powder coat]<Insert finish>.
    b. Color: [As indicated by manufacturer's designations][Match Architect's sample][As selected by Architect from manufacturer's full range][Light

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bronze][Medium bronze][Dark bronze]<Insert color>.

8. Stainless Steel: [0.0781 inch]<Insert dimension> thick sheet.

    a. Finish: [Manufacturer's standard]<Insert finish>.

9. Fabrication:

    a. Curb Profile: [Manufacturer's standard][Profile as indicated on Drawings] compatible with roofing system.
    b. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
    c. Minimum Height: Fabricate curbs to minimum height of [12 inches]<Insert dimension> above roofing surface unless otherwise indicated.
    d. Top Surface: Level top of curb, with roof slope accommodated [by sloping deck-mounting flange][or][by use of leveler frame].
    e. Sloping Roofs: Where roof slope exceeds 1/4 inch per 12 inches, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
    f. Insulation: Factory insulated with [1-1/2-inch-]<Insert dimension> thick glass-fiber board insulation.
    g. Liner: Same material as curb, of manufacturer's standard thickness and finish.
    h. Nailer: Factory-installed wood nailer [along top flange of curb][under top flange on side of curb], continuous around curb perimeter.
    i. Wind-Restraint Straps and Base Flange Attachment: Provide wind-restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to comply with wind-uplift requirements.
    j. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from 3/4-inch- thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
    k. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.
    l. Security Grille: [Provide for all units][Provide where indicated].
    m. Damper Tray: Provide damper tray or shelf with opening [3 inches]<Insert dimension>[less than interior curb dimensions indicated][of size indicated].

2.3 EQUIPMENT SUPPORTS

A. Equipment Support: Metal equipment support capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements

    1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include,

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but are not limited to, the following:

a. [AES Industries, Inc]
b. [Air Balance; MESTEK, Inc.]
c. [Conn-Fab Sales, Inc]
d. [Curbs Plus, Inc]
e. [Greenheck Fan Corporation]
f. [JL Industries; Activar Construction Products Group, Inc.]
g. [KCC Manufacturing]
h. [Lloyd Industries, Inc.]
i. [LMCurbs]
j. [Louvers & Dampers, Inc.; Mestek, Inc.]
k. [Pate Company (The)]
l. [Plenums of Florida Incorporated]
m. [Portals Plus; Duravent Group]
n. [RCS Fabrications Inc.]
o. [Roof Products and Systems (RPS); Duravent Group]
p. [Roof Products, Inc.]
q. [Thybar Corporation]
r. [Vent Products Co., Inc]
s. <Insert manufacturer's name>

2. Type: [Internally reinforced perimeter][Rail type].
3. Corner Joints: Welded [or mechanically fastened and sealed].
4. Curb Sides: [Integral metal cant][Stepped integral metal cant to raise the thickness of roof insulation] and integrally formed structure-mounting flange at bottom.
5. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
6. Supported Load Capacity: [Coordinate load capacity with information on Shop Drawings of equipment to be supported]<Insert load requirements>.
7. Steel: [Zinc-coated (galvanized)][Aluminum-zinc alloy-coated] steel sheet, [0.052 inch][0.064 inch][0.079 inch]<Insert dimension> thick.

    a. Finish: Powder coat.
    b. Color: As selected by Architect from manufacturer's full range.

8. Aluminum: [0.090 inch][0.125 inch]<Insert dimension> thick sheet.

    a. Finish: Powder coat.
    b. Color: As selected by Architect from manufacturer's full range.

9. Stainless Steel: [0.0781 inch]<Insert dimension> thick sheet.

    a. Finish: [Manufacturer's standard]<Insert finish>.

10. Construction:

    a. Curb Profile: [Manufacturer's standard][Profile as indicated on Drawings] compatible with roofing system.
    b. Insulation: Factory insulated with [1-1/2-inch-]<Insert dimension> thick

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glass-fiber board insulation.

c. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
d. Nailer: Factory-installed continuous wood nailers [3-1/2 inches][5-1/2 inches]<Insert dimension> wide [on top flange of equipment supports][under top flange on side of curb], continuous around support perimeter.
e. Wind-Restraint Straps and Base Flange Attachment: Provide wind-restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb of size and spacing required to comply with wind-uplift requirements.
f. Platform Cap: Where portion of equipment support is not covered by equipment, provide weathertight platform cap formed from 3/4-inch- thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
g. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
h. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
i. Fabricate equipment supports to minimum height of [12 inches]<Insert dimension> above roofing surface unless otherwise indicated.
j. Sloping Roofs: Where roof slope exceeds 1/4 inch per 12 inches, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.
k. Security Grille: [Provide for all units][Provide where indicated on Drawings].

2.4 PIPE AND DUCT SUPPORTS

A. Fixed-Height Cradle-Type Pipe Supports: Polycarbonate pipe stand accommodating pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.

1. Maximum Diameter Pipe or Conduit: [1-1/2 inches]<Insert dimension>.

B. Fixed-Height Roller-Bearing Pipe Supports: Polycarbonate pipe stand with roller carrying assembly accommodating pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.

1. Roller Carrying Assembly Material: [Polycarbonate][Stainless steel].
2. Maximum Diameter Pipe or Conduit: [7 inches]<Insert dimension>.

C. Adjustable-Height Roller-Bearing Pipe Supports: Polycarbonate pipe stand base, pipe support, and roller housing, with stainless steel threaded rod designed for adjusting support height, accommodating pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.

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1. Maximum Diameter Pipe or Conduit: [18 inches]<Insert dimension>.

D. Adjustable-Height Structure-Mounted Pipe Supports: Extruded-aluminum tube, filled with urethane insulation; accommodating pipe or conduit, with provision for pipe retainer; with aluminum baseplate, EPDM base seal, manufacturer's recommended hardware for mounting to structure or structural roof deck as indicated, stainless steel roller and retainer, and extruded-aluminum carrier assemblies; as required for quantity of pipe runs and sizes.

1. Aluminum Tube Diameter: [2 inches]<Insert dimension>.
2. Maximum Diameter Pipe or Conduit: [7 inches]<Insert dimension>.

E. Duct Supports: Extruded-aluminum, urethane-insulated supports, with manufacturer's recommended hardware for mounting to structure or structural roof deck.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. [Roof Products and Systems (RPS); Duravent Group]
b. [Thaler Metal Industries Ltd.]
c. <Insert manufacturer's name>

2. Aluminum Tube Diameter: [2 inches]<Insert dimension>.
3. Finish: [Manufacturer's standard]<Insert finish>.

2.5 PREFORMED FLASHING SLEEVES

A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, with removable metal hood and metal collar.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. [Custom Solution Roof and Metal Products, a division of Colony Heating]
b. [Menzies Metal Products]
c. [Thaler Metal Industries Ltd.]
d. <Insert manufacturer's name>

2. Height: [12 inches]<Insert dimension>.
3. Metal Collar: [Slotted][Perforated].
4. Metal: Aluminum sheet, [0.063 inch]<Insert thickness> thick.
5. Diameter: [As indicated on Drawings][3 inches][4 inches][5 inches][6 inches][7 inches][8 inches][9 inches][10 inches]<Insert dimension>.
6. Finish: [Manufacturer's standard]<Insert finish>.

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B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. [Custom Solution Roof and Metal Products, a division of Colony Heating]
    b. [Menzies Metal Products]
    c. [Milcor by Duravent; Duravent Group.]
    d. [Thaler Metal Industries Ltd.]
    e. <Insert manufacturer's name>

2. Metal: [Aluminum sheet, 0.063 inch thick]<Insert material and thickness>.
3. Height: [7 inches][13 inches][19 inches]<Insert dimension>.
4. Diameter: [As indicated on Drawings][2 inches][3 inches][4 inches][5 inches][6 inches]<Insert dimension>.
5. Finish: [Manufacturer's standard]<Insert finish>.

2.6 ROOF WALKWAYS

A. Roof Walkway: Metal planking formed from multiple C-shaped channels with upper surface punched in serrated diamond or rectangular shapes to produce raised slip-resistant surface and drainage holes. Provide support framing, brackets, connectors, nosings, and other accessories and components needed for complete installation.

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. [Atkore Unistrut]
    b. [Cooper B-line; brand of Eaton, Electrical Sector]
    c. [Kee Safety, Inc.]
    d. [MIRO Industries Inc.]
    e. [PHP Systems/Design]
    f. <Insert manufacturer's name>

2. Compliance Requirements:

    a. Include step units or stairs of similar construction for changes in elevation. Comply with ASCE/SEI 7, 29 CFR 1910.23, and requirements of authorities having jurisdiction.
    b. Equip walkways with safety railings where required to comply with local building codes and requirements of authorities having jurisdiction.

3. Plank Width: [4-3/4 inches][7 inches][9-1/2 inches][11-3/4 inches][18-3/4 inches][24 inches][As indicated].
4. Walkway Width: [As indicated]<Insert dimension>.
5. Channel Depth: [1-1/2 inches][2 inches][2-1/2 inches][3 inches][As indicated].
6. Metal Material: [0.079-inch- thick zinc-coated (galvanized) steel sheet][0.108-

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inch- thick zinc-coated (galvanized) steel sheet][0.0625-inch- thick stainless steel sheet][0.0781-inch- thick stainless steel sheet][0.080-inch- thick aluminum sheet][0.100-inch- thick aluminum sheet]<Insert material and thickness>, perforated, with serrated slip-resistant walking surface.

7. Support Stands: Manufacturer's standard, with protective pads compatible with roofing material.
8. Support Pads: Continuous wood isolation pads, pressure-preservative treated as specified in Section 061000 "Rough Carpentry"; attach roof-walkway supports to pads so that supports are separated from roof membrane surface and walkway support loads are distributed evenly.
9. Wind Restraint: Provide wind-restraint attachment to roof structure of size and spacing required to comply with wind-uplift requirements.
10. Finish: [Manufacturer's standard]<Insert finish>.

2.7 METAL MATERIALS

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent.

B. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheer complying with minimum ASTM A653/A653M, G90 coating designation or aluminum-zinc alloy-coated steel sheet complying with minimum ASTM A792/A792M, Class AZ50 coating designation; structural quality.

1. Mill-Phosphatized Finish: Manufacturer's standard for field painting.
2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil.
3. Powder Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

C. Aluminum Sheet: ASTM B209/B209M, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.

1. Mill Finish: As manufactured.
2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil.
3. Clear Anodic Finish: AAMA 611, [AA-M12C22A41, Class I, 0.018 mm][AA-M12C22A31, Class II, 0.010 mm] or thicker.
4. Color Anodic Finish: AAMA 611, [AA-M12C22A42/A44, Class I, 0.018 mm][AA-M12C22A32/A34, Class II, 0.010 mm] or thicker.
5. Powder Coat Finish: AAMA 2603. After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.

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6. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

D. Aluminum Extrusions and Tubes: ASTM B221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.

E. Stainless Steel Sheet and Shapes: ASTM A240/A240M or ASTM A666, Type 304.

F. Steel Shapes: ASTM A36/A36M, hot-dip galvanized in accordance with ASTM A123/A123M unless otherwise indicated.

G. Steel Tube: ASTM A500/A500M, round tube.

H. Galvanized-Steel Tube: ASTM A500/A500M, round tube, hot-dip galvanized in accordance with ASTM A123/A123M.

I. Steel Pipe: ASTM A53/A53M, galvanized.

2.8 UNDERLAYMENT

A. Felt Underlayment: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

B. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

2.9 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Acrylic Glazing: ASTM D4802, thermoformable, monolithic sheet, manufacturer's standard, Type UVA (formulated with UV absorber), Finish 1 (smooth or polished).

C. Polycarbonate Glazing: Thermoformable, monolithic polycarbonate sheets manufactured by extrusion process, burglar-resistance rated in accordance with UL 972 with an average impact strength of [12 to 16 ft. lbf/in.]<Insert value> of width when tested in accordance with ASTM D256, Method A (Izod).

D. Cellulosic-Fiber Board Insulation: ASTM C208, Type II, Grade 1, thickness as indicated.

E. Glass-Fiber Board Insulation: ASTM C726, nominal density of 3 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F, thickness as indicated.

F. Polyisocyanurate Board Insulation: ASTM C1289, thickness and thermal resistivity as indicated.

G. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for

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aboveground use, acceptable to authorities having jurisdiction, [containing no arsenic or chromium,] and complying with AWPA C2; not less than 1-1/2 inches thick.

H. Security Grilles: [3/4-inch]<Insert dimension> diameter, ASTM A1011/A1011M steel bars spaced [6 inches]<Insert dimension> o.c. in one direction and [12 inches]<Insert dimension> o.c. in the other; factory finished as follows:

1. Surface Preparation: Remove mill scale and rust, if any, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment.
3. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, lead- and chromate-free, universal primer; selected for resistance to normal atmospheric corrosion, for compatibility with substrate and field-applied finish paint system indicated, and for capability to provide a sound foundation for field-applied topcoats under prolonged exposure.

I. Fasteners: Roof accessory manufacturer's recommended fasteners, designed to comply with performance requirements, suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

1. Fasteners for Metallic-Coated Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel in accordance with ASTM A153/A153M or ASTM F2329/F2329M.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.

J. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

K. Elastomeric Sealant: ASTM C920, elastomeric [polyurethane][silicone] polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

L. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

M. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

N. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

2.10 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA AMP 500 for recommendations for applying and designating finishes.

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B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

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

3.2 INSTALLATION, GENERAL

A. Install roof accessories in accordance with manufacturer's written instructions.

1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended in writing by manufacturer's written installation instructions.

1. Coat concealed side of [uncoated aluminum][and][stainless steel] roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Seal joints with [elastomeric][or][butyl] sealant as required by roof accessory manufacturer.

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3.3 INSTALLATION OF ROOF ACCESSORIES

A. Roof Curbs: Install each roof curb so top surface is level.

B. Equipment Supports: Install equipment supports so top surfaces are level with each other.

C. Roof Hatches:

1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
2. Attach safety railing system to roof-hatch curb.
3. Attach ladder-assist post in accordance with manufacturer's written instructions.

D. Heat and Smoke Vents:

1. Install heat and smoke vents so top perimeter surfaces are level.
2. Install and test heat and smoke vents and their components for proper operation in accordance with NFPA 204.

E. Gravity Ventilators: Verify that gravity ventilators operate properly and have unrestricted airflow. Clean, lubricate, and adjust operating mechanisms.

F. Pipe and Duct Supports: Comply with MSS SP-58. Install supports and attachments as required to properly support piping. Arrange for grouping of parallel runs of horizontal piping, and support together.

1. Pipes of Various Sizes: Space supports for smallest pipe size or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.

G. Preformed Flashing Sleeves: Secure flashing sleeve to roof membrane in accordance with flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane in accordance with roof membrane manufacturer's instructions.

H. Security Grilles: Weld bar intersections and [, using tamper-resistant bolts, attach the] ends of bars to structural frame or primary curb walls.

3.4 INSTALLATION OF ROOF WALKWAYS

A. Verify that locations of access and servicing points for roof-mounted equipment are served by locations of roof walkways.

B. Remove ballast from top surface of low-slope roofing at locations of contact with roof-walkway supports.

C. Install roof-walkway support pads prior to placement of roof-walkway support stands onto low-slope roofing.

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D. Redistribute removed ballast after installation of support pads.

3.5 CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing in accordance with ASTM A780/A780M.

B. Touch up factory-primed surfaces with compatible primer ready for field painting in accordance with [Section 099113 "Exterior Painting."][Section 099114 "Exterior Painting (MPI Standards."]

C. On completion of installation, clean exposed surfaces in accordance with manufacturer's written instructions. Clean off excess sealants.

3.6 PROTECTION

A. Remove temporary protective coverings and strippable films as roof accessories are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof accessories in a clean condition during construction.

B. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 077200

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SECTION 077233

ROOF HATCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Work included: Furnishing and installing factory fabricated roof hatches.

1.2 SUBMITTALS

A. Product Data: Provide manufacturer's product data for all materials in this specification.

B. Shop Drawings: Show profiles, accessories, location, and dimensions.

C. Samples: Manufacturer to provide upon request; sized to represent material adequately.

D. Contract Closeout: Roof hatch manufacturer shall provide the manufacturer's Warranty prior to the contract closeout.

1.3 WARRANTY

A. Manufacturer's standard warranty: Materials shall be free of defects in material and workmanship for a period of five years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

1.4 PRODUCT HANDLING

A. All materials shall be delivered in manufacturer's original packaging.

B. Store materials in a dry, protected, well-vented area. The contractor shall thoroughly inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

C. Remove protective wrapping after installation.

1.5 JOB CONDITIONS

A. Verify that other trades with related work are complete before installing roof hatch(s).Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

B. Mounting surfaces shall be straight and secure; substrates shall be of proper width.

C. Refer to the construction documents, shop drawings, and manufacturer's installation instructions.

D. Coordinate installation with roof membrane and roof insulation manufacturer's instructions before starting.

E. Observe all appropriate OSHA safety guidelines for this work.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis of Design: The Bilco Company

B. Or approved equal

2.2 Roof Hatch

A. Furnish and install where indicated on plans metal roof hatch:

1. Type: S

2. Size: Field Verify.

3. The roof hatch shall be single leaf.

4. The roof hatch shall be pre-assembled from the manufacturer.

B. Performance characteristics:

1. Cover shall be reinforced to support a minimum live load of 40 psf (195kg/m2) with a maximum deflection of 1/150th of the span or 20 psf wind uplift.

2. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.

3. Operation of the cover shall not be affected by temperature.

4. Entire hatch shall be weathertight with fully welded corner joints on cover and curb.

C. Cover: Shall be 11 gauge aluminum with a 3" (76mm) beaded flange with formed reinforcing members. Cover shall have a heavy extruded EPDM rubber gasket that is bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.

D. Cover insulation: Shall be fiberglass of 1" (25.4mm) thickness, fully covered and protected by a metal liner of 18 gauge aluminum.

E. Curb: Shall be 12" (305mm) in height and 11 gauge aluminum. The curb shall be formed with a 3-1/2" (89mm) flange with 7/16" (11.1mm) holes provided for securing to the roof deck. The

curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, fully welded at the corners, that features the Bil-Clip® flashing system, including stamped tabs, 6” (153mm) on center, to be bent inward to hold single ply roofing membrane securely in place.

F. Curb insulation: Shall be rigid, high-density fiberboard of 1” (25.4mm) thickness on outside of curb.

G. Lifting mechanisms: Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe welded to the curb assembly.

H. Hardware

1. Heavy pintle hinges shall be provided

2. Cover shall be equipped with a spring latch with interior and exterior turn handles

3. Roof hatch shall be equipped with interior and exterior padlock hasps.

4. The latch strike shall be a stamped component bolted to the curb assembly.

5. Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1” diameter red vinyl grip handle to permit easy release for closing.

6. Compression spring tubes shall be an anti-corrosive composite material and all other hardware shall be zinc plated and chromate sealed. Springs shall have an electrocoated acrylic finish for corrosion resistance.

7. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.

I. Finish: Mill finished aluminum.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that roof hatch installation will not disrupt other trades. Verify that the substrate is dry, clean, and free of foreign matter. Report and correct defects prior to any installation.

3.2 INSTALLATION

A. Submit product design drawings for review and approval to the architect or specifier before fabrication.

B. The installer shall check as-built conditions and verify the manufacturer’s roof hatch details for accuracy to fit the application prior to fabrication. The installer shall comply with the roof hatch Manufacturer's installation instructions.

C. The installer shall furnish mechanical fasteners consistent with the roof requirements.

END OF SECTION

SECTION 077253 - SNOW GUARDS

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1. Pad-type, flat-mounted metal snow guards.
2. Pad-type, flat-mounted plastic snow guards.
3. Pad-type, seam-mounted cast-metal snow guards.
4. Pad-type, seam-mounted plastic snow guards.
5. Rail-type, flat-mounted snow guards.
6. Rail-type, seam-mounted snow guards.

B. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.

1. Include details of rail-type snow guards.

C. Samples:

1. Pad-Type Snow Guards: Full-size unit with installation hardware.

a. For units with factory-applied finishes, submit [manufacturer's standard color selections][specified color].

2. Rail-Type Snow Guards: Bracket, 12-inch- long rail, and installation hardware.

a. For units with factory-applied finishes, submit [manufacturer's standard color selections][specified color].

D. Delegated Design Submittals: For snow guards, include analysis reports signed and sealed by the qualified professional engineer responsible for their preparation.

1. Include calculation of number and location of snow guards.

1.2 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that the engineer is licensed in the [jurisdiction][state] in which the Project is located.

B. Product Test Reports: For each type of snow guard, for tests performed by a qualified testing agency, indicating load at failure of attachment to roof system identical to roof system used on this Project.

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1.3 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit adhesive-mounted snow guards to be installed, and adhesive cured, according to adhesive manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design snow guards, including attachment to roofing material and roof deck, as applicable for attachment method, based on the following:

1. Roof snow load.
2. Snow drifting
3. Roof slope.
4. Roof type.
5. Roof dimensions.
6. Roofing substrate type and thickness.
7. Snow guard type.
8. Snow guard fastening method and strength.
9. Snow guard spacing.
10. Coefficient of Friction Between Snow and Roof Surface: 0.
11. Factor of Safety: [2][3]<Insert factor of safety>.

B. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1. Temperature Change: [120 deg F, ambient; 180 deg F, material surfaces]<Insert temperature change>.

C. Structural Performance: Snow guards to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Snow Loads: [As indicated on Drawings]<Insert loading requirements>.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.

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1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

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

3.2 PREPARATION

A. Clean and prepare substrates for bonding snow guards.

B. Prime substrates according to snow guard manufacturer's written instructions.

3.3 INSTALLATION

A. Install snow guards according to manufacturer's written instructions.

1. Space rows as indicated on [Drawings][Shop Drawings].
2. Space rows as recommended by manufacturer.

B. Attachment for Asphalt Shingle Roofing:

1. Pad-Type, Flat-Mounted Snow Guards: [Mechanically anchored through each factory-prepared hole with fasteners concealed by the shingles][Retrofit mechanical anchor and counterflashing sleeve system]<Insert attachment>.
2. Rail-Type, Flat-Mounted, Snow Guards: [Mounting plates bolted or screwed to the roof framing or roof deck]<Insert requirement>.

C. Attachment for Wood Shingle and Shake Roofing:

D. Attachment for Standing-Seam Metal Roofing:

1. Do not use fasteners that will penetrate metal roofing or fastening methods that void metal roofing finish warranty.
2. Pad-Type, Flat-Mounted Snow Guards:

    a. [Mechanically attach][Adhere] to metal roofing in accordance with manufacturer's written instructions.
    b. Solder to copper roofing in accordance with manufacturer's written instructions.

3. Pad-Type, Seam-Mounted Snow Guards:

    a. Install snow guards in straight rows.
    b. Secure in place using stainless steel set screws, incorporating round nonpenetrating point.
    c. Torque set screw in accordance with manufacturer's written instructions.

E. Attachment for Exposed Fastened Metal Roofing:

1. Do not use fasteners that will void metal roofing finish warranty.

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2. Pad-Type, Flat-Mounted Snow Guards:

    a. Adhere to metal roofing in accordance with manufacturer's written instructions.
    b. Mechanically fasten to metal roofing, using fasteners identical to those used to secure metal roofing to substrate.
    c. Solder to copper roofing in accordance with manufacturer's written instructions.

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SECTION 078123 - INTUMESCENT FIRE PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Related Requirements:

1. Section 078100 "Applied Fire Protection" for sprayed fire-resistive materials (SFRM).
2. Section 099646 "Intumescent Painting" for intumescent paints that are fire retarding, but not fire resistive.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]<Insert location>.

1. Review products, design ratings, restrained and unrestrained conditions, thicknesses, and other performance requirements.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Mastic and intumescent fire-resistive coatings.
2. Substrate primers.
3. Reinforcing fabric.
4. Reinforcing mesh.
5. Topcoat.

B. Shop Drawings: Framing plans or schedules, or both, indicating the following:

1. Extent of fire protection 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 mastic and intumescent fire-resistive coating thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
4. Treatment of mastic and intumescent fire-resistive coating after application.

C. Samples: For each exposed product and for each color and texture specified, [in manufacturer's standard dimensions][4 inches square]<Insert dimensions> in size.

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1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For [Installer][and][testing agency].

B. Product Certificates: For each type of mastic and intumescent fire-resistive coating.

C. Evaluation Reports: For mastic and intumescent fire-resistive coating, from ICC-ES.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by mastic and intumescent fire-resistive coating manufacturer as experienced and with sufficient trained staff to install manufacturer's products in accordance with 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 fire protection and different substrate][and][each required finish]<Insert description> 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.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not apply fire protection when ambient or substrate temperature is [50 deg F]<Insert temperature> 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 fire protection, providing complete air exchanges in accordance with manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fire protection dries thoroughly.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Assemblies: Provide fire protection, including auxiliary materials, in accordance with requirements of each fire-resistance design and manufacturer's written instructions.

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B. Source Limitations: Obtain fire protection [for each fire-resistance design] from single source.

C. Fire-Resistance Design: Indicated on Drawings, tested in accordance with [ASTM E119 or UL 263]<Insert requirement>; 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 AUXILIARY MATERIALS

A. Provide auxiliary materials that are compatible with mastic and intumescent fire-resistive coating 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 mastic and intumescent fire-resistive coating 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 mastic and intumescent fire-resistive coating manufacturer.

D. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by mastic and intumescent fire-resistive coating manufacturer. Include pins and attachment.

E. Topcoat: Suitable for application over mastic and intumescent fire-resistive coating; of type recommended in writing by mastic and intumescent fire-resistive coating 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 in accordance with 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 fire protection with substrates under conditions of normal use or fire exposure.
2. Verify that objects penetrating fire protection, including clips, hangers, support

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sleeves, and similar items, are securely attached to substrates.

3. Verify that substrates receiving fire protection are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fire protection application.

B. Conduct tests in accordance with mastic and intumescent fire-resistive coating 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 fire protection materials during application.

B. Clean substrates of substances that could impair bond of fire protection.

C. Prime substrates where included in fire-resistance design and where recommended in writing by mastic and intumescent fire-resistive coating manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fire protection.

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 fire protection. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

A. Construct fire protection 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 fire protection Work.

B. Comply with mastic and intumescent fire-resistive coating manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fire protection; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fire protection with other construction to minimize need to cut or remove fire protection.

1. Do not begin applying fire protection until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
2. Defer installing ducts, piping, and other items that would interfere with applying

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fire protection until application of fire protection is completed.

D. Install auxiliary materials as required, as detailed, and in accordance with fire-resistance design and mastic and intumescent fire-resistive coating 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 mastic and intumescent fire-resistive coating manufacturer.

E. Spray apply fire protection 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 mastic and intumescent fire-resistive coating manufacturer.

F. Extend fire protection in full thickness over entire area of each substrate to be protected.

G. Install body of fire protection in a single course unless otherwise recommended in writing by mastic and intumescent fire-resistive coating manufacturer.

H. Provide a uniform finish complying with description indicated for each type of fire protection material and matching finish approved for required mockups.

I. Cure fire protection in accordance with mastic and intumescent fire-resistive coating manufacturer's written instructions.

J. Do not install enclosing or concealing construction until after fire protection has been applied, inspected, and tested and corrections have been made to deficient applications.

K. Finishes: Where indicated, apply fire protection to produce the following finishes:

1. Manufacturer's Standard Finishes: Finish in accordance with 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: [Owner will engage][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."][as indicated on Schedule of Special Inspections.]<Insert requirement.>

B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fire protection for the next area until test results for previously completed applications of fire protection show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.

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C. Fire protection will be considered defective if it does not pass tests and inspections.

1. Remove and replace fire protection that does not pass tests and inspections, and retest.
2. Apply additional fire protection, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

D. Prepare test and inspection reports.

3.5 CLEANING

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.

3.6 PROTECTION

A. Protect fire protection, in accordance with advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fire protection is without damage or deterioration at time of Substantial Completion.

3.7 REPAIRS

A. As installation of other construction proceeds, inspect fire protection and repair damaged areas and fire protection removed due to work of other trades.

B. Repair fire protection damaged by other work before concealing it with other construction.

C. Repair fire protection by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 078123

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SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Penetration firestopping systems.

1. Penetration firestopping systems in fire-resistance-rated walls.
2. Penetration firestopping systems in horizontal assemblies.
3. Penetration firestopping systems in smoke barriers.
4. Exposed penetration firestopping systems.

B. Related Requirements:

1. Section 078443 "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.
2. Section 079200 "Joint Sealants" for non-fire-resistance-rated joint sealants.
3. Section 079219 "Acoustical Joint Sealants" for sealing joints in sound-rated construction.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]<Insert location>.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

C. Unlisted Firestopping Systems: Obtain an Engineering Judgment (EJ) from firestopping manufacturer where no UL, FM Approvals, or other listed assembly is available for particular firestop configuration. Follow International Firestop Council (IFC) recommended guidelines for evaluating firestopping systems in EJs.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly developed in accordance with current International Firestop Council (IFC) recommended guidelines. Obtain approval of authorities having jurisdiction prior to submittal.

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1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Listed System Designs: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Entity that has been approved by FM Approvals in accordance with FM Approvals 4991 or been evaluated by UL Solutions and found to comply with "UL Solutions Qualified Firestop Contractor Program."

B. Manufacturer Qualifications: Entity that has received UL Solutions' "Firestop Movement Certification," which demonstrates that manufacturer's firestopping products designated with M-Ratings are based on exposure to cyclic movement and UL 1479 fire test evaluation when tested in accordance with ASTM E3037.

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of each penetration firestopping system type required for Project, including supporting construction substrates, attachments, and accessories.
2. Where one penetration firestopping system type may be used for different penetrating items or in different wall or floor constructions, install one assembly for each different combination.
3. Obtain approval of mockups from authorities having jurisdiction before proceeding.
4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping systems when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost,

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condensation, or other causes.

B. Install and cure penetration firestopping system materials in accordance with manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be accessed and installed in accordance with specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain penetration firestopping systems for each type of opening indicated from single manufacturer.

2.2 ACCESSORIES

A. Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated, including but not limited to:

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.3 FILL MATERIALS

A. Cast-in-Place Firestopping Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestopping Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

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D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric strips for use around combustible penetrants.

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: Compressible, removable, and reusable intumescent pillows encased in fire-retardant polyester or glass-fiber cloth. Where exposed, and when required by a listed system, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed or dislodged.

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.

K. Thermal and Endothermic Wraps: Flexible, insulating, and fire-resistant protective wraps tested and listed for up to 2-hour fire ratings in accordance with ASTM E814 or UL 1479; for protecting membrane penetrations of utility boxes, critical electrical circuits, communications lines, and fuel lines, and for thermal barrier and circuit integrity protection in accordance with ASTM E1725 or UL 1724.

L. Fire-Rated Cable Sleeve Kits: Complete kits designed for new or existing cable penetrations through walls which accept standard accessories.

M. Fire-Rated Cable Pathways: Single or gangable device modules composed of a steel raceway with integral intumescent material and requiring no additional action in the form of plugs, twisting closure, putty, pillows, sealant, or otherwise to achieve fire and air-leakage ratings.

1. Fire-rated cable pathway devices are the preferred product for data, video, and communications cable penetrations. Install these devices in locations where frequent cable moves, add-ons, and changes will occur. Such devices must be:

    a. Capable of retrofit around existing cables.
    b. Designed so that two or more devices can be ganged together.
    c. Maintenance-free so no action is required to activate the smoke- and fire-sealing mechanism.

2. Where fire-rated cable pathway devices are not practical, openings within walls and floors designed to accommodate data, video, and communications cabling must be provided with re-enterable products specifically designed for retrofit, such as retrofit devices for cable bundles, firestopping putty, plugs, or pillows.

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N. Retrofit Device for Cable Bundles: Factory-made, intumescent, collar-like device for firestopping existing over-filled cable sleeves and capable of being installed around projecting sleeves and cable bundles.

O. Wall-Opening Protective Materials: Intumescent, non-curing putty pads or self-adhesive inserts for protection of electrical switch and receptacle boxes.

P. Fire-Rated HVAC Retaining Angles: Steel angle system with integral intumescent firestopping gasket for use around rectangular steel HVAC ducts without fire dampers.

Q. Firestopping Plugs: Flexible, re-enterable, intumescent, foam-rubber plug for use in blank round openings and cable sleeves.

R. Fire-Rated Cable Grommet: Molded two-piece grommet made of plenum-grade polymer and foam inner core for sealing small cable penetrations in gypsum walls up to 1/2 inch in diameter.

S. Closet Flange Gasket: Molded, single-component, flexible, intumescent gasket for use beneath a water closet (toilet) flange in floor applications.

2.4 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping 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 the Work.

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

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings in accordance with manufacturer's written instructions and with the following requirements:

1. Remove foreign materials from substrate surfaces that could interfere with adhesion of penetration firestopping materials.

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2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates in accordance with penetration firestopping system manufacturer's written installation instructions, using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 ft. from end of wall and at intervals not exceeding 30 ft..

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.4 FIELD QUALITY CONTROL

A. Owner will engage a qualified inspection agency to conduct and report on inspections in accordance with ASTM E2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

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3.5 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping 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 penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

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SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Intumescent gypsum wall framing gaskets.
2. Joints in or between fire-resistance-rated construction.
3. Joints in smoke barriers.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers [and for wall identification].
2. Section 079513.13 "Interior Expansion Joint Cover Assemblies" for fire-resistive manufactured expansion-joint cover assemblies for interior floors, walls, and ceilings.
3. Section 079513.16 "Exterior Expansion Joint Cover Assemblies" for fire-resistive manufactured expansion-joint cover assemblies for exterior building walls, soffits, and parapets.
4. Section 079513.19 "Parking Deck Expansion Joint Cover Assemblies" for fire-resistive manufactured expansion-joint cover assemblies subject to vehicular traffic.
5. Section 092216 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]<Insert location>.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

B. Unlisted Firestopping Systems: Obtain an Engineering Judgment (EJ) from firestop manufacturer where no UL, FM Approvals, or other listed assembly is available for particular firestop configuration. Follow International Firestop Council (IFC) recommended guidelines for evaluating firestop systems in EJs.

C. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

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1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an EJ or equivalent fire-resistance-rated assembly developed in accordance with current IFC guidelines.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Listed System Designs: For each joint firestopping system, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written installation instructions.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approvals in accordance with FM Approvals 4991 or been evaluated by UL and found to comply with UL's "UL Solutions Qualified Firestop Contractor Program."

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure joint firestopping systems in accordance with manufacturer's written installation instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of joints to ensure that joint firestopping systems can be installed in accordance with specified firestopping system design.

B. Coordinate sizing of joints to accommodate joint firestopping systems.

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PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain joint firestop systems for each type of joint opening indicated from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. A qualified testing agency, acceptable to authorities having jurisdiction, will perform joint firestopping system tests.
2. Test in accordance with testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:

    a. Joint firestop systems installed with products bearing the classification marking of a qualified product certification agency in accordance with listed system designs published by a qualified testing agency.

        1) UL in its online directory "Product iQ."
        2) Intertek Group in its "Directory of Building Products."
        3) <Insert name of qualified testing agency>.

B. Rain/Water Resistance: For perimeter fire-barrier system applications, where inclement weather or greater-than-transient water exposure is expected, use products that dry rapidly and cure in the presence of atmospheric moisture sufficient to pass ASTM D6904 early rain-resistance test (24-hour exposure).

2.3 JOINT FIRESTOPPING SYSTEM TYPES

A. General: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems must accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

1. Joint firestopping systems that are compatible with one another, with the substrates forming openings, and with penetrating items, if any.
2. Provide products that, upon curing, do not re-emulsify, dissolve, leach, break down, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture.
3. Provide firestop products that do not contain ethylene glycol.

B. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined in accordance with ASTM E84.

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2.4 ACCESSORIES

A. Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Surface Cleaning: Before installing joint firestopping systems, clean joints in accordance with fire-resistive joint system manufacturer's written installation instructions and the following requirements:

1. Remove foreign materials from substrate surfaces that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates in accordance with joint firestopping system manufacturer's written installation instructions, using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Apply a suitable bond breaker to prevent three-sided adhesion in applications where condition occurs.

3.3 INSTALLATION

A. General: Install joint firestopping systems in accordance with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

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1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:

1. Apply elastomeric fill in voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 ft. from end of wall and at intervals not exceeding 30 ft..

B. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge, so labels are visible to anyone seeking to remove joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections in accordance with ASTM E2393.

B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.

C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

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3.6 CLEANING AND PROTECTION

A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated joint firestopping systems immediately and install new materials to produce joint firestopping systems complying with specified requirements.

3.7 JOINT FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's online directory "Product iQ" under product [Category XHBN][or][Category XHDG].

B. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Building Products" under product category [Expansion/Seismic Joints][or][Firestop Systems].

C. Floor-to-Floor, Joint Firestopping Systems: .

1. UL-Classified Systems: FF- [D][S] - <Insert four-digit number>[0000-0999][1000-1999][2000-2999][3000-3999][4000-4999].
2. Assembly Rating: [One hour][Two hours]<Insert number of hours>.
3. Nominal Joint Width: [As indicated]<Insert dimension>.
4. Movement Capabilities: [Class I][Class II][Class III] - <Insert number> percent [compression or extension][compression, extension, or horizontal shear].
5. L-Rating at Ambient: Less than <Insert cfm/ft.>.
6. L-Rating at 400 Deg F (204 Deg C): Less than <Insert cfm/ft.>.
7. W-Rating: No leakage of water at completion of water-leakage testing.

D. Wall-to-Wall, Joint Firestopping Systems: .

1. UL-Classified Systems: WW- [D][S] - <Insert four-digit number>[0000-0999][1000-1999][2000-2999][3000-3999][4000-4999].
2. Assembly Rating: [One hour][Two hours]<Insert number of hours>.
3. Nominal Joint Width: [As indicated]<Insert dimension>.
4. Movement Capabilities: [Class I][Class II][Class III] - <Insert number> percent [compression or extension].
5. L-Rating at Ambient: Less than <Insert cfm/ft.>.
6. L-Rating at 400 Deg F (204 Deg C): Less than <Insert cfm/ft.>.

E. Floor-to-Wall, Joint Firestopping Systems: .

1. UL-Classified Systems: FW- [D][S] - <Insert four-digit number>[0000-0999][1000-1999][2000-2999][3000-3999][4000-4999].
2. Assembly Rating: [One hour][Two hours]<Insert number of hours>.
3. Nominal Joint Width: [As indicated]<Insert dimension>.

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4. Movement Capabilities: [Class I][Class II][Class III] - <Insert number> percent [compression or extension][compression, extension, or horizontal shear].
5. L-Rating at Ambient: Less than <Insert cfm/ft.>.
6. L-Rating at 400 Deg F (204 Deg C): Less than <Insert cfm/ft.>.

F. Head-of-Wall, Fire-Resistive Joint Firestopping Systems: .

1. UL-Classified Systems: HW- [D][S] - <Insert four-digit number>[0000-0999][1000-1999][2000-2999][3000-3999][4000-4999].
2. Intertek Group-Listed Systems: <Insert design number>.
3. Assembly Rating: [One hour][Two hours]<Insert number of hours>.
4. Nominal Joint Width: [As indicated]<Insert dimension>.
5. Movement Capabilities: [Class I][Class II][Class III] - <Insert number> percent [compression or extension].
6. L-Rating at Ambient: Less than <Insert cfm/ft.>.
7. L-Rating at 400 Deg F (204 Deg C): Less than <Insert cfm/ft.>.

G. Bottom-of-Wall, Joint Firestopping Systems: .

1. UL-Classified Systems: BW- [D][S] - <Insert four-digit number>[0000-0999][1000-1999][2000-2999][3000-3999][4000-4999].
2. Assembly Rating: [One hour][Two hours]<Insert number of hours>.
3. Nominal Joint Width: [As indicated]<Insert dimension>.
4. Movement Capabilities: [Class I][Class II][Class III] - <Insert number> percent [compression or extension].
5. L-Rating at Ambient: Less than <Insert cfm/ft.>.
6. L-Rating at 400 Deg F (204 Deg C): Less than <Insert cfm/ft.>.

H. Wall-to-Wall, Joint Firestopping Systems Intended for Use as Corner Guards: .

1. UL-Classified Systems: CG- [D][S] - <Insert four-digit number>[0000-0999][1000-1999][2000-2999][3000-3999][4000-4999].
2. Assembly Rating: [One hour][Two hours]<Insert number of hours>.
3. Nominal Joint Width: [As indicated]<Insert dimension>.
4. Movement Capabilities: [Class I][Class II][Class III] - <Insert number> percent [compression or extension].
5. L-Rating at Ambient: Less than <Insert cfm/ft.>.
6. L-Rating at 400 Deg F (204 Deg C): Less than <Insert cfm/ft.>.

I. Perimeter Joint Firestopping Systems: .

1. UL-Classified Perimeter Fire-Containment Systems: CW- [D][S] - <Insert four-digit number>[0000-0999][1000-1999][2000-2999].
2. Intertek Group-Listed, Perimeter Fire-Barrier Systems: <Insert design number>.
3. Integrity Rating: [One hour][Two hours]<Insert number of hours>.
4. Insulation Rating: [Zero hour][1/4 hour][3/4 hour][1 hour]<Insert number of hours>.
5. Linear Opening Width: [2-1/2 inches][8 inches][As indicated]<Insert dimension>, maximum.
6. Movement Capabilities: [Class I][Class II][Class III] - <Insert number> percent [

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compression or extension].

7. F-Rating: [One hour][Two hours]<Insert number of hours>.

END OF SECTION 078443

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SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Requirements:

1. Section 079100 "Preformed Joint Seals" for preformed compressible foam and precured joint seals.
2. Section 079219 "Acoustical Joint Sealants" for sealing joints in sound-rated construction.
3. Section 321373 "Concrete Paving Joint Sealants" for sealing joints in paved roads, parking lots, walkways, and curbing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]<Insert location>.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Immersible joint sealants.
5. Silane-modified polymer joint sealants.
6. Mildew-resistant joint sealants.
7. Polysulfide joint sealants.
8. Butyl joint sealants.
9. Latex joint sealants.

B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

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

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

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

1.4 INFORMATIONAL SUBMITTALS

A. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:

1. Joint-sealant location and designation.
2. Manufacturer and product name.
3. Type of substrate material.
4. Proposed test.
5. Number of samples required.

B. Preconstruction Laboratory Test Reports: For each joint sealant and substrate material to be tested from sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

C. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

D. Field Quality-Control Reports: For field-adhesion-test reports, for each sealant application tested.

E. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Manufacturers' special warranties.

B. Installer's special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

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1.7 MOCKUPS

A. Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with [stone][masonry]<Insert substrate> substrates.
4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each kind of sealant and joint substrate.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
5. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.

    a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

6. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.

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7. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.9 FIELD CONDITIONS

A. 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.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.10 WARRANTY

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

1. Warranty Period: [Two]<Insert number> years from date of Substantial Completion.

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

1. Warranty Period: [Five]<Insert number> years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from 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.

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PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain joint sealants from single manufacturer [for each sealant type].

2.2 JOINT SEALANTS, 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 joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: [As indicated by manufacturer's designations][Match Architect's samples][As selected by Architect from manufacturer's full range].

2.3 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested in accordance with ASTM C1248.

2.4 IMMERSIBLE JOINT SEALANTS

A. Immersible Joint Sealants: Suitable for immersion in liquids; ASTM C1247, [Class 1][Class 2]; tested in deionized water unless otherwise indicated.

2.5 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

2.6 JOINT-SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for

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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 to 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 performance of the Work.

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, 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 after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.
    d. Exterior insulation and finish systems.
    e. <Insert other porous joint substrate>.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

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a. Metal.
b. Glass.
c. Porcelain enamel.
d. Glazed surfaces of ceramic tile.
e. <Insert other nonporous joint substrate>.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by 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 or primer 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 C1193 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 in accordance with requirements specified in subparagraphs 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.

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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 profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.
4. Provide flush joint profile at [locations indicated on Drawings]<Insert locations> in accordance with Figure 8B in ASTM C1193.
5. Provide recessed joint configuration of recess depth and at [locations indicated on Drawings]<Insert locations> in accordance with Figure 8C in ASTM C1193.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: [Owner will engage][Engage] a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

    a. Extent of Testing: Test completed and cured sealant joints as follows:

        1) Perform [10]<Insert number> tests for the first [1000 ft.]<Insert dimension> of joint length for each kind of sealant and joint substrate.
        2) Perform one test for each [1000 ft.]<Insert dimension> of joint length thereafter or one test per each floor per elevation.

    b. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.

        1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

    c. Inspect tested joints and report on the following:

        1) Whether sealants filled joint cavities and are free of voids.
        2) Whether sealant dimensions and configurations comply with specified requirements.
        3) Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

    d. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and

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percent elongations, sealant material, sealant configuration, and sealant dimensions.

e. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

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

C. Prepare test and inspection reports.

3.5 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.

3.6 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, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

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SECTION 079219 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Acoustical joint sealants.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for elastomeric, latex, and butyl-rubber-based joint sealants for nonacoustical applications.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants, showing full range of available colors for each product exposed to view.

C. Samples for Verification: For each type and color of acoustical joint sealant required.

1. Size: 1/2-inch- wide sealant joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Acoustical Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.3 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports:

1. Product Test Reports: For each type of acoustical joint sealant, for tests performed by [qualified testing agency][manufacturer and witnessed by a qualified testing agency].

B. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Warranty Documentation:

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1. Manufacturers' special warranties.
2. Installer's special warranties.

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 between 40 and 95 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 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between [35 and 100 deg F][60 and 90 deg F]. [Warm surfaces to be coated to 70 deg F to enhance drying.]

1.7 WARRANTY

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

1. Warranty Period: [Two]<Insert number> years from date of Substantial Completion.

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

1. Warranty Period: <Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACOUSTICAL JOINT SEALANTS

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

2.2 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by acoustical joint-sealant manufacturer where required for adhesion of sealant to joint substrates.

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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 to 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 acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, 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. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where recommended by acoustical joint-sealant manufacturer. 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 or primer 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 ACOUSTICAL JOINT SEALANTS

A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.

B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written instructions for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of

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moldings before they are installed.

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 acoustical joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect acoustical 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, remove, and repair damaged or deteriorated acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079219

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SECTION 079513.13 - INTERIOR EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.

1. Floor expansion joint covers.
2. Wall expansion joint covers.
3. Ceiling expansion joint covers.

B. Shop Drawings: For each expansion joint cover assembly.

1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams showing entire route of each expansion joint.
2. Where expansion joint cover assemblies change planes, provide isometric or clearly detailed drawing depicting how components interconnect.

C. Samples: For each expansion joint cover assembly and for each color and texture specified, full width by 6 inches long in size.

D. Samples for Initial Selection: For each type of exposed finish.

1. Include manufacturer's color charts showing the full range of colors and finishes available for each exposed metal and elastomeric-seal material.

E. Samples for Verification: For each type of expansion joint cover assembly, full width by 6 inches long in size.

F. Expansion Joint Cover Assembly Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:

1. Manufacturer and model number for each expansion joint cover assembly.
2. Expansion joint cover assembly location cross-referenced to Drawings.
3. Nominal, minimum, and maximum joint width.
4. Movement direction.
5. Materials, colors, and finishes.
6. Product options.
7. Fire-resistance ratings.

1.2 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each fire-resistance-rated expansion joint cover assembly, for tests performed by [manufacturer and witnessed by a qualified testing agency][a

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qualified testing agency].

1.3 MOCKUPS

A. Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockup of typical expansion joint cover assembly 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.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Furnish units in longest practicable lengths to minimize field splicing.

B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Expansion joint cover assemblies to withstand the effects of earthquake motions determined according to [ASCE/SEI 7]<Insert requirement>.

B. Fire-Resistance Ratings: Provide expansion joint cover assemblies with fire barriers identical to those of systems tested for fire resistance according to [UL 2079][or][ASTM E1966] by a qualified testing agency.

1. Hose Stream Test: Wall-to-wall and wall-to-ceiling assemblies to be subjected to hose stream testing.

C. Expansion Joint Design Criteria :

1. Type of Movement: [Thermal][Wind sway].

a. Nominal Joint Width: [As indicated on Drawings]<Insert width>.
b. Minimum Joint Width: [As indicated on Drawings]<Insert width>.
c. Maximum Joint Width: [As indicated on Drawings]<Insert width>.

2. Seismic Movement:

a. Joint Movement: As indicated on Drawings.

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2.3 MATERIALS

A. Aluminum: ASTM B221, Alloy 6063-T5 for extrusions; ASTM B209, Alloy 6061-T6 for sheet and plate.

1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.

B. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304 for plates, sheet, and strips.

C. Brass: ASTM B36/B36M, UNS Alloy C26000 for half hard sheet and coil.

D. Bronze: ASTM B455, Alloy C38500 for extrusions; Alloy C23000 red brass for plates.

E. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes or extrusions to be installed in metal frames.

F. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to comply with performance criteria for required fire-resistance rating.

G. Moisture Barrier: Manufacturer's standard, flexible elastomeric material.

H. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.4 ALUMINUM FINISHES

A. Mill finish.

B. Clear Anodic Finish: AAMA 611, [AA-M12C22A41, Class I, 0.018 mm][AA-M12C22A31, Class II, 0.010 mm] or thicker.

C. Color Anodic Finish: AAMA 611, [AA-M12C22A42/A44, Class I, 0.018 mm][AA-M12C22A32/A34, Class II, 0.010 mm] or thicker.

2.5 ACCESSORIES

A. Moisture Barriers: Manufacturer's standard continuous, waterproof membrane within joint and attached to substrate on sides of joint.

1. Provide where indicated on Drawings.

B. Manufacturer's [standard][stainless steel] attachment devices. Include anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces where expansion joint cover assemblies will be installed for installation tolerances and other conditions affecting performance of the Work.

B. Notify Architect where discrepancies occur that will affect proper expansion joint cover assembly installation and performance.

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

3.2 PREPARATION

A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.

B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

3.3 INSTALLATION

A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.

B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.

1. Repair or grout block out as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
2. Install frames in continuous contact with adjacent surfaces.
    a. Shimming is not permitted.
3. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
4. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
5. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.

C. Seals: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.

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1. Provide in continuous lengths for straight sections.
2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

D. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.

E. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.

F. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion joint cover assembly materials and associated work so complete assemblies comply with performance requirements.

1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

G. Moisture Barrier Drainage: If indicated, provide drainage fittings and connect to drains.

3.4 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion joint cover assemblies. Reinstall cover plates or seals prior to Substantial Completion.

END OF SECTION 079513.13

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SECTION 079513.16 - EXTERIOR EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Related Requirements:

1. Section 077129 "Manufactured Roof Expansion Joints" for factory-fabricated roof expansion joint cover assemblies.
2. Section 079100 "Preformed Joint Seals" for preformed foam and extruded-silicone joint seals.
3. Section 079513.19 "Parking Deck Expansion Joint Cover Assemblies" for expansion joint cover assemblies subject to vehicular traffic.

1.2 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.

1. Exterior expansion joint covers.

B. Shop Drawings: For each expansion joint cover assembly.

1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams showing entire route of each expansion joint.
2. Where expansion joint cover assemblies change planes, provide isometric or clearly detailed drawing depicting how components interconnect.

C. Samples: For each exposed expansion joint cover assembly and for each color and texture specified, full width by 6 inches long in size.

D. Samples for Initial Selection: For each type of exposed finish.

1. Include manufacturer's color charts showing the full range of colors and finishes available for each exposed metal and elastomeric seal material.

E. Samples for Verification: For each type of expansion joint cover assembly, full width by 6 inches long in size.

F. Expansion Joint Cover Assembly Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:

1. Manufacturer and model number for each expansion joint cover assembly.
2. Expansion joint cover assembly location cross-referenced to Drawings.
3. Nominal, minimum, and maximum joint width.

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4. Movement direction.
5. Materials, colors, and finishes.
6. Product options.
7. Fire-resistance ratings.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each fire-resistance-rated expansion joint cover assembly, for tests performed by [manufacturer and witnessed by a qualified testing agency][a qualified testing agency].

1.4 MOCKUPS

A. Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockup of typical expansion joint cover assembly 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.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Furnish units in longest practicable lengths to minimize field splicing.

B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Expansion joint cover assemblies shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7]<Insert requirement>.

B. Fire-Resistance Ratings: Provide expansion joint cover assemblies with fire barriers identical to those of systems tested for fire resistance according to [UL 2079][or][ASTM E1966] by a qualified testing agency.

1. Hose Stream Test: Wall-to-wall and wall-to-soffit assemblies shall be subjected to hose stream testing.

C. Expansion Joint Design Criteria :

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1. Type of Movement: [Thermal][Wind sway].

    a. Nominal Joint Width: [As indicated on Drawings]<Insert width>.
    b. Minimum Joint Width: [As indicated on Drawings]<Insert width>.
    c. Maximum Joint Width: [As indicated on Drawings]<Insert width>.

2. Seismic Movement:

    a. Joint Movement: As indicated on Drawings.

2.3 MATERIALS

A. Aluminum: ASTM B221, Alloy 6063-T5 for extrusions; ASTM B209, Alloy 6061-T6 for sheet and plate.

    1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.

B. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304 for plates, sheet, and strips.

C. Brass: ASTM B36/B36M, UNS Alloy C26000 for half hard sheet and coil.

D. Bronze: ASTM B455, Alloy C38500 for extrusions; Alloy C23000 red brass for plates.

E. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes or extrusions to be installed in metal frames.

F. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to comply with performance criteria for required fire-resistance rating.

G. Moisture Barrier: Manufacturer's standard, flexible elastomeric material.

2.4 ALUMINUM FINISHES

A. Mill finish.

B. Clear Anodic Finish: AAMA 611, [AA-M12C22A41, Class I, 0.018 mm][AA-M12C22A31, Class II, 0.010 mm] or thicker.

C. Color Anodic Finish: AAMA 611, [AA-M12C22A42/A44, Class I, 0.018 mm][AA-M12C22A32/A34, Class II, 0.010 mm] or thicker.

2.5 ACCESSORIES

A. Moisture Barriers: Manufacturer's standard continuous, waterproof membrane within joint and attached to substrate on sides of joint.

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1. Provide where indicated on Drawings.

B. Manufacturer's [standard][stainless steel] attachment devices. Include anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces where expansion joint cover assemblies will be installed for installation tolerances and other conditions affecting performance of the Work.

B. Notify Architect where discrepancies occur that will affect proper expansion joint cover assembly installation and performance.

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

3.2 PREPARATION

A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.

B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

3.3 INSTALLATION

A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.

B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.

1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
4. Install frames in continuous contact with adjacent surfaces.

    a. Shimming is not permitted.

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5. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.

C. Elastomeric Seals: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.

1. Provide in continuous lengths for straight sections.
2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
3. Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

D. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.

E. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.

F. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion joint cover assembly materials and associated work so complete assemblies comply with performance requirements.

1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

G. Moisture Barrier Drainage: If indicated, provide drainage fitting and connect to drains.

3.4 CONNECTIONS

A. Transition to Roof Expansion Joint Covers: Coordinate installation of exterior wall and soffit expansion joint covers with roof expansion joint covers specified in Section 077129 "Manufactured Roof Expansion Joints." [Install factory-fabricated units at transition between exterior walls and soffits and roof expansion joint cover assemblies.]

3.5 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect the installation from damage by work of other Sections.

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SECTION 081213 - HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Borrowed lite frames.

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames" for hollow metal doors and frames.
2. Section 081119 "Stainless-Steel Doors and Frames" for hollow metal doors and frames manufactured from stainless steel.
3. Section 083473.13 "Metal Sound Control Door Assemblies" for packaged, acoustically rated, hollow metal door and frame assemblies.
4. [Section 087100 "Door Hardware"][Section 087111 "Door Hardware (Descriptive Specification)"] for door hardware for hollow metal doors.
5. Section 119812 "Detention Doors and Frames" for hollow metal doors and frames for detention facilities.
6. Section 134900 "Radiation Protection" for lead-lined, hollow metal doors and frames.

1.2 DEFINITIONS

A. Minimum Steel Sheet Thickness: Minimum thickness of base metal without coatings in accordance with [ANSI/SDI A250.8][NAAMM-HMMA 803].

1.3 COORDINATION

A. Coordinate installing anchors for hollow metal frames, including sleeves, concrete inserts, and anchor bolts.

B. Coordinate requirements for installing door hardware, including electrified door hardware, and access control and security systems.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference [at Project site][by web conference]<Insert location>.

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1.5 ACTION SUBMITTALS

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

1. Include construction details, material descriptions, core descriptions, and finishes.
2. Include information indicating compliance with performance requirements indicated.

B. Shop Drawings:

1. Elevations of each frame type.
2. Frame details for each frame type, including dimensioned profiles and base-metal thicknesses.
3. Locations of reinforcement and preparations for hardware.
4. Details of each wall opening condition.
5. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
6. Details of frame anchors, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.

C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for frames with factory-applied color finishes.

D. Samples for Verification: For factory applied color finishes, prepared on Samples of not less than [3 by 5 inches]<Insert requirements>.

E. Product Schedule: For hollow metal frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings used on the Drawings and in schedules. Coordinate with doors and final door hardware schedule.

F. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party-Certified Life-Cycle Assessment: For each product.

1.6 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For tests performed by [a qualified testing agency][manufacturer and witnessed by a qualified testing agency] for the following:

1. Fire-rated door assemblies.
2. Smoke- and draft-control door assemblies.
3. Fire-rated borrowed lite assemblies.
4. Windborne-debris impact resistant door assemblies.

B. Oversize Construction Certification: For assemblies required to be fire-rated that exceed limitations of labeled assemblies.

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C. Field Quality Control Reports: For doors and frames.

D. Qualification Statements: For field testing and inspecting agency [and][Fire-Rated Door Inspector][Egress Door Inspector].

1.7 CLOSEOUT SUBMITTALS

A. Record Documents: For [fire-rated][and][smoke- and draft-control] door assemblies, list of door numbers and applicable room name and number to which door provides access.

1.8 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Documented as complying with requirements in NFPA 80 [and having Door and Hardware Institute's Certified Fire + Egress Door Assembly Inspector (CFDAI) credentials]<Insert requirements>.

B. Egress Door Inspector Qualifications: Documented as complying with requirements in NFPA 101 [and having Door and Hardware Institute's Certified Fire + Egress Door Assembly Inspector (CFDAI) credentials]<Insert requirements>.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic, canvas, or other material that can entrap moisture.

1. Provide additional protection to prevent damage to factory-applied color finishes.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal frames vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking.

D. Immediately remove and replace damaged or wet packaging or protective material.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain hollow metal frames from single manufacturer.

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2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Complying with requirements in NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated [on Drawings][in schedules], based on testing at positive pressure in accordance with NFPA 252 or UL 10C.

1. Temperature-Rise Limit: Where indicated [on Drawings][in schedules], provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.
2. 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.

B. Sidelite and Transom Frames: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated [on Drawings][in schedules], based on testing in accordance with ASTM E119 or UL 263.

C. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control based on testing in accordance with UL 1784 by a qualified testing agency acceptable to authorities having jurisdiction.

D. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing in accordance with NFPA 257 or UL 9.

E. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone [1][2][3][4].

1. Basic Protection: Conduct large-missile testing on assemblies to be installed up to 30 ft. above grade and small-missile testing on assemblies to be installed at higher elevations.
2. Enhanced Protection: Conduct large-missile testing on assemblies regardless of installation elevation above grade.

2.3 BORROWED LITES

A. Borrowed Lite Frames:

1. Minimum Base-Metal Thickness: [0.042 inch][0.053 inch][except 0.067-inch for openings greater than 4 ft. in any direction].
2. Steel Sheet: Uncoated.
3. Construction: Full-profile welded.

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2.4 ACCESSORIES

A. Hollow Metal Infill Panels: Match materials, construction, and finish of adjacent door.

B. Frame Anchors: ANSI/SDI 250.4; steel sheet; minimum base-metal thickness required by door and frame standard indicated.

1. Interior Locations: ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.
2. Exterior-Wall Anchors: ASTM A653/653M, [A40][A60] metallic coating.
3. Jamb Anchors: Of minimum size and type required by door and frame standard indicated, and suitable for performance level indicated.

    a. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 ft..
    b. Postinstalled Expansion Anchor: Minimum 3/8-inch- diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

4. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
5. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips that allow 2-inch height adjustment. Terminate bottom of frames at top of underlayment.

2.5 MATERIALS

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

B. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.

F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

G. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

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H. Glazing: Comply with requirements in Section 088000 "Glazing."

2.6 FABRICATION

A. Hollow Metal Frames:

1. Welded Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles, at each joint, fabricated from metal of same or greater thickness as frames.
2. Sidelite 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 welding [, or by rigid mechanical anchors].
3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
4. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers. 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.

5. Terminated Stops (Hospital Stops): Terminate stops [6 inches]<Insert dimension> above finish floor with a 90 -degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.
6. Thermally Broken Frames: Provide manufacturer's standard frame construction with a split running continuously along the frame length, filled with an insert of low-thermal conducting material joining the two portions.

B. Hardware Preparation: Factory prepare hollow metal frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the door hardware required, and templates.

1. Reinforce frames to receive nontemplated, mortised, and surface-mounted hardware.
2. Comply with ANSI/SDI A250.14 for preparing hollow metal frames for hardware.

2.7 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

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

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B. Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, complying with ANSI/SDI A250.3.

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. 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. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap frames to receive nontemplated, mortised, and surface-mounted hardware.

3.3 INSTALLATION OF BORROWED LITE FRAMES

A. Install in accordance with ANSI/SDI A250.8 and ANSI/SDI A250.11.

B. Mineral-Fiber Insulation: Solidly pack mineral-fiber insulation inside frames.

C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow metal door and frame manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

A. Inspection Agency: [Owner will engage][Engage] a qualified inspector to perform tests and inspections and to furnish reports to Architect.

B. Fire-Rated Door Acceptance Testing: Test and inspect fire-rated doors in accordance with NFPA 80.

C. Smoke- and Draft-Control Door Acceptance Testing: Test and inspect smoke- and draft-control door assemblies in accordance with NFPA 105.

D. Egress-Door Acceptance Testing: Test and inspect egress doors in accordance with

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NFPA 101.

E. Repair or remove and replace installations where testing and inspections indicate noncompliance with specified requirements.

F. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

G. Inspection Report: Prepared and submitted in writing to Architect and Contractor within 24 hours after testing.

3.5 ADJUSTING

A. Remove and replace defective work, including frames that are warped, bowed, or otherwise defective.

3.6 CLEANING

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint in accordance with manufacturer's written instructions.

C. Factory-Applied Color Finish Touchup: Clean abraded areas and repair with same material used for factory finish in accordance with manufacturer's written instructions.

END OF SECTION 081213

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SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core seven-ply flush wood veneer-faced doors and transom panels for transparent finish.
2. Solid-core flush wood doors and transom panels with plastic-laminate-faces.
3. Hollow-core flush wood doors with plastic-laminate faces.

B. Related Requirements:

1. Section 064023 "Interior Architectural Woodwork" for wood door frames [including 20-minute fire-rated wood door frames].
2. Section 064216 "Flush Wood Paneling" for requirements for veneers from the same flitches for both flush wood doors and flush wood paneling.
3. Section 083473.16 "Wood Sound Control Door Assemblies" for acoustic flush wood doors.
4. Section 088000 "Glazing" for glass view panels in flush wood doors.
5. [Section 099113 "Exterior Painting"][Section 099123 "Interior Painting"][and][Section 099300 "Staining and Transparent Finishing"] for field finishing doors.
6. Section 134900 "Radiation Protection" for lead-lined flush wood doors.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]<Insert location>.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Solid-core five-ply flush wood veneer-faced doors and transom panels for transparent finish.
2. Solid-core five-ply flush wood doors and transom panels for opaque finish.
3. Solid-core seven-ply flush wood veneer-faced doors and transom panels for transparent finish.
4. Solid-core seven-ply flush wood doors and transom panels for opaque finish.
5. Solid-core flush wood doors and transom panels with plastic-laminate-faces.
6. Hollow-core flush wood veneer-faced doors for transparent finish.
7. Hollow-core flush wood doors for opaque finish.
8. Hollow-core flush wood doors with plastic-laminate faces.
9. Fire-rated wood door frames.

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10. Light frames and louvers.

B. Product Data Submittals: For each product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Door louvers.
5. Door trim for openings.
6. Door frame construction.
7. Factory-machining criteria.
8. Factory- [priming][finishing] specifications.

C. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party Certified Life Cycle Assessment: For each product.
3. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.

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

1. Door schedule indicating door [and frame] location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of frame for each frame type, including dimensions and profile.
4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
5. Dimensions and locations of blocking for hardware attachment.
6. Dimensions and locations of mortises and holes for hardware.
7. Clearances and undercuts.
8. Requirements for veneer matching.
9. Doors to be factory [primed][finished] and application requirements.
10. Apply [AWI Quality Certification][WI Certified Compliance] Program label to Shop Drawings.

E. Samples for Initial Selection: For [plastic-laminate door faces][polymer edging][factory-finished doors][and][factory-finished door frames].

F. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. [For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.]
2. Plastic laminate, 6 inches square, for each color, texture, and pattern selected.
3. Polymer edging, in manufacturer's standard colors.
4. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.

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5. Louver blade and frame sections, 6 inches long, for each material and finish specified.
6. Frames for light openings, 6 inches long, for each material, type, and finish required.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For door inspector.

1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
3. Submit copy of DHI's Fire and Egress Door Assembly Inspector (FDAI) certificate.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Special warranties.

B. Quality Standard Compliance Certificates: [AWI Quality Certification][WI Certified Compliance] Program certificates.

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

1.6 QUALITY ASSURANCE

A. Manufacturer's Certification: Licensed participant in [AWI's Quality Certification Program][WI's Certified Compliance Program].

B. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies complies with qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

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

1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

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1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in [plastic bags or cardboard cartons][cardboard cartons, and wrap bundles of doors in plastic sheeting].

C. Mark each door on [top and] bottom rail with opening number used on Shop Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.
2. Do not deliver or install doors until building is enclosed and weathertight, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between [25 and 55][43 and 70][17 and 50]<Insert numbers> percent during remainder of construction period.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors [and frames] that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Delamination of veneer.
b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty also includes installation and finishing that may be required due to repair or replacement of defective doors [and frames].
3. Warranty Period for Solid-Core Exterior Doors: [Two][Five]<Insert number> years from date of Substantial Completion.
4. Warranty Period for Solid-Core Interior Doors: Life of installation.
5. Warranty Period for Hollow-Core Interior Doors: [One][Two]<Insert number> year(s) from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain flush wood doors [indicated to be blueprint matched with paneling][and wood paneling] from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Wood Door and Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings [and temperature-rise limits] indicated on Drawings, based on testing at positive pressure in accordance with [UL 10C][or][NFPA 252].

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
2. Temperature-Rise Limit: [Where indicated on Drawings][At vertical exit enclosures and exit passageways], provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.

B. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

2.3 FLUSH WOOD DOORS AND FRAMES, GENERAL

A. Quality Standard: In addition to requirements specified, comply with [AWI/AWMAC/WI's "Architectural Woodwork Standards."][ANSI/WDMA I.S. 1A.]

1. Provide [labels][and][certificates] from [AWI][WI] certification program indicating that doors [and frames] comply with requirements of grades specified.

    a. This project has been registered with AWI as AWI Quality Certification Program Number <Insert number>.
    b. Contractor registers the Work under this Section with the AWI Quality Certification Program at www.awiqcp.org or by calling 855-345-0991.

2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with the Contract Documents in addition to those of the referenced quality standard.

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2.4 SOLID-CORE SEVEN-PLY FLUSH WOOD VENEER-FACED DOORS AND TRANSOM PANELS FOR TRANSPARENT FINISH

A. Interior Doors, Seven-Ply Veneer-Faced:

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. [Haley Brothers, Inc]
    b. [Lambton Doors]
    c. [Vancouver Door Company]
    d. <Insert manufacturer's name>

2. Performance Grade: ANSI/WDMA I.S. 1A as indicated on Drawings.
3. Performance Grade by Location:

    a. ANSI/WDMA I.S. 1A Extra Heavy Duty: [Classrooms][public toilets][janitor's closets][assembly spaces][exits][and][patient rooms]<Insert locations>[and where indicated on Drawings].
    b. ANSI/WDMA I.S. 1A Standard Duty: [Closets (not including janitor's closets)][and][private toilets]<Insert locations>[and where indicated on Drawings].

4. ANSI/WDMA I.S. 1A Quality Grade: Premium.
5. Architectural Woodwork Standards Quality Grade: Premium.
6. Faces: two-ply wood panel with wood veneer not less than 1/50 inch thick.

    a. Species: Select white maple.
    b. Cut: Quarter sliced.
    c. Match between Veneer Leaves: Book match.
    d. Assembly of Veneer Leaves on Door Faces: Balance match.
    e. Pair and Set Match: Provide for doors hung in same opening [or separated only by mullions].
    f. Room Match:

        1) Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 10 feet or more.
        2) Provide door faces of compatible color and grain within each separate room or area of building.

    g. Transom Match: Continuous match.
    h. Blueprint Match: Where indicated, provide doors with faces produced from same flitches as adjacent wood paneling and arranged to provide blueprint match with wood paneling. Comply with requirements in Section 064216 "Flush Wood Paneling."

7. Exposed Vertical and Top Edges: Same species as faces - Architectural Woodwork Standards edge Type A.

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a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
b. Fire-Rated Pairs of Doors:

1) Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
2) Provide formed-steel edges and astragals with intumescent seals.

a) Finish steel edges and astragals with baked enamel [same color as doors].
b) Finish steel edges and astragals to match door hardware (locksets or exit devices).

c. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

1) Screw-Holding Capability: 550 lbf in accordance with WDMA T.M. 10.

8. Core for non-fire-rated doors, ANSI A208.1, Grade LD-1 particleboard.

a. Blocking: Provide wood blocking in particleboard-core doors as [needed to eliminate through-bolting hardware.][follows:]

1) 5-inch top-rail blocking, in doors indicated to have closers.
2) 5-inch bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
3) 5-inch midrail blocking, in doors indicated to have exit devices.

b. Provide doors with [glued-wood-stave][or][WDMA I.S. 10 structural-composite-lumber] cores instead of particleboard cores for doors scheduled to receive exit devices in [Section 087100 "Door Hardware."][Section 087111 "Door Hardware (Descriptive Specification."]

9. Core for non-fire-rated doors, glued wood stave.
10. Core for non-fire-rated doors, WDMA I.S. 10 structural composite lumber.

a. Screw Withdrawal, Door Face: 550 lbf.
b. Screw Withdrawal, Vertical Door Edge: 550 lbf.

11. Core for non-fire-rated doors, either glued wood stave or WDMA I.S. 10 structural composite lumber.
12. Core for fire-rated doors, as required to achieve fire-protection rating indicated on Drawings.

a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as [needed to eliminate through-

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bolting hardware.][follows:]

1) 5-inch top-rail blocking.
2) 5-inch bottom-rail blocking, in doors indicated to have protection plates.
3) 5-inch midrail blocking, in doors indicated to have armor plates.
4) [4-1/2-by-10-inch lock blocks][5-inch midrail blocking], in doors indicated to have exit devices.

13. Construction: Seven plies, [hot-pressed][or][cold-pressed], bonded or unbonded.

2.5 LIGHT FRAMES AND LOUVERS

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: [Same species as door faces][Species compatible with door faces][Any closed-grain hardwood].
2. Profile: [Flush rectangular beads][Recessed tapered beads][Recessed tapered beads with exposed banding][Lipped tapered beads][Manufacturer's standard shape].
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated on Drawings. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

C. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch- thick, cold-rolled steel sheet; [factory primed for paint][with baked-enamel- or powder-coated] finish; and approved for use in doors of fire-protection rating indicated on Drawings.

D. Wood Louvers: Door manufacturer's standard solid-wood louvers unless otherwise indicated.

1. Wood Species: [Same species as door faces][Species compatible with door faces][Any closed-grain hardwood].
2. Profile: [Flat][Chevron].

2.6 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated.

1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
2. Comply with NFPA 80 requirements for fire-rated doors.

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B. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-WDHS-3.
2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
5. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Transom and Side Panels:

1. Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors.
2. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
3. Fabricate door and transom panels with full-width, solid-lumber [, rabbeted,] meeting rails.
4. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.

D. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
3. Louvers: Factory install louvers in prepared openings.

E. Exterior Doors: Factory treat exterior doors with water repellent after fabrication has been completed but before factory [priming][finishing].

1. Flash top of outswinging doors with manufacturer's standard metal flashing.

2.7 FACTORY PRIMING

A. Doors for Opaque Finish: Factory prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in [Section 099113 "Exterior Painting."][Section 099123" Interior Painting."]

2.8 FACTORY FINISHING

A. Comply with referenced quality standard for factory finishing.

1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
2. Finish faces, all four edges, edges of cutouts, and mortises.
3. Stains and fillers may be omitted on [top and] bottom edges, edges of cutouts,

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and mortises.

B. Factory finish doors.

C. Factory finish doors that are indicated on Drawings to receive transparent finish.

D. Factory finish doors where indicated in schedules or on Drawings as factory finished.

E. Transparent Finish:

1. Architectural Woodwork Standards Grade: Premium.

   a. System-5, Varnish, Conversion.
   b. System-9, UV Curable, Acrylated Epoxy, Polyester or Urethane.
   c. System-10, UV Curable, Water Based.
   d. System-11, Polyurethane, Catalyzed.

2. ANSI/WDMA I.S. 1A Grade: Premium.

   a. TR-4 Conversion Varnish.
   b. TR-6 Catalyzed Polyurethane.
   c. TR-8 UV Cured Acrylated Polyester/Urethane.

3. Staining: As selected by Architect from manufacturer's full range.
4. Sheen: Satin.

F. Opaque Finish:

1. Architectural Woodwork Standards Grade: Premium.

   a. System-5, Varnish, Conversion.
   b. System-9, UV Curable, Acrylated Epoxy, Polyester, or Urethane.
   c. System-10, UV Curable, Water Based.
   d. System-11, Polyurethane, Catalyzed.

2. ANSI/WDMA I.S. 1A Grade: Premium.

   a. OP-4 Conversion Varnish.
   b. OP-6 Catalyzed Polyurethane.

3. Color: As selected by Architect from manufacturer's full range.
4. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

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1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

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

3.2 INSTALLATION

A. Hardware: For installation, see [Section 087100 "Door Hardware."][Section 087111 "Door Hardware (Descriptive Specification)."]

B. Install doors [and frames] to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

C. Install frames level, plumb, true, and straight.

1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
2. Anchor frames to anchors or blocking built in or directly attached to substrates.
    a. Secure with countersunk, concealed fasteners and blind nailing.
    b. Use fine finishing nails [or finishing screws] for exposed fastening, countersunk and filled flush with woodwork.
        1) For factory-finished items, use filler matching finish of items being installed.
3. Install fire-rated doors and frames in accordance with NFPA 80.
4. Install smoke- and draft-control doors in accordance with NFPA 105.

D. Job-Fitted Doors:

1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
    a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
2. Machine doors for hardware.
3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
4. Clearances:
    a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
    b. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
    c. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
    d. Comply with NFPA 80 for fire-rated doors.

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5. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
6. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.

E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

F. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: [Owner will engage][Engage] a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Provide inspection of installed Work through [AWI's Quality Certification Program][WI's Certified Compliance Program], certifying that wood doors and frames, including installation, comply with requirements of AWI/AWMCA/WI's "Architectural Woodwork Standards" for the specified grade.
2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
3. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in [NFPA 80][and][NFPA 101].

3.4 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

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SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flush access doors with exposed flanges.
2. Fire-rated access doors with exposed flanges.

B. Related Requirements:

1. Section 077200 "Roof Accessories" for roof hatches.
2. Section 083113.53 "Security Access Doors and Frames" for access doors and frames for security applications.
3. Section 083123 "Floor Doors" for doors installed in floors.
4. Section 233300 "Air Duct Accessories" for heating and air-conditioning duct access doors.

1.2 ALLOWANCES

A. See Section 012100 "Allowances" for description of allowances affecting items specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details [, fire ratings,] material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches in size.

C. Product Schedule: For access doors and frames. [Use same designations indicated on Drawings.]

1.4 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Reports: For fire-rated door inspections.

B. Qualification Statements: For testing and inspecting agency.

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

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Section 5.2.3.1.

2. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies complies with the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection [and temperature-rise limit] ratings indicated, in accordance with NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Exposed Flanges:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. ACUDOR Products, Inc
    b. Babcock-Davis
    c. Nystrom, Inc.

2. Description: Face of door flush with frame, with exposed flange and concealed hinge.
3. Optional Features: Gasketing Masonry anchors.
4. Locations: Wall and ceiling.
5. Door Size: <Insert door size>.
6. Uncoated Steel Sheet for Door: [Nominal 0.060 inch, 16 gage]<Insert thickness>, factory primed.
7. Metallic-Coated Steel Sheet for Door: [Nominal 0.064 inch, 16 gage]<Insert

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thickness>, factory primed.
8. Stainless Steel Sheet for Door: [Nominal 0.062 inch, 16 gage]<Insert thickness>, ASTM A480/A480M No. 4 finish.
9. Frame Material: [Same material, thickness, and finish as door]<Insert material, thickness, and finish>.
10. Latch and Lock: Cam latch, key operated.

2.3 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated Access Doors with Exposed Flanges:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. ACUDOR Products, Inc
    b. Babcock-Davis
    c. Nystrom, Inc.

2. Description: Door flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with exposed flange, self-closing door, and concealed hinge.
3. Door Type:

    a. Flush.
    b. Recessed 5/8 inch for gypsum board.

4. Optional Features: [Upward-opening doors for ceilings][Gasketing][Double-leaf doors][Piano hinges][Masonry anchors]<Insert feature>.
5. Locations: Wall and ceiling.
6. Door Size: <Insert door size>.
7. Fire-Resistance Rating: Not less than that of adjacent construction.
8. Temperature-Rise Rating: 450 deg F at the end of 30 minutes.
9. Uncoated Steel Sheet for Door: [Nominal 0.036 inch, 20gage]<Insert thickness>, factory primed.
10. Metallic-Coated Steel Sheet for Door: [Nominal 0.040 inch, 20 gage]<Insert thickness>, factory primed.
11. Stainless Steel Sheet for Door: [Nominal 0.038 inch, 20 gage]<Insert thickness>, ASTM A480/A480M No. 4 finish.
12. Frame Material: [Same material, thickness, and finish as door]<Insert material, thickness, and finish>.
13. Latch and Lock: Self-latching door hardware, operated by key.

2.4 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled

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steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.

D. Stainless Steel Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, [Type 304][Type 316]. Remove tool and die marks and stretch lines, or blend into finish.

E. Stainless Steel Flat Bars: ASTM A666, [Type 304][Type 316]. Remove tool and die marks and stretch lines, or blend into finish.

F. Aluminum Extrusions: ASTM B221, Alloy 6063.

G. Aluminum Sheet: ASTM B209/B209M, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

H. Frame Anchors: Same material as door face.

I. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329/F2329M.

2.5 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 mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.

D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.

1. For recessed doors with plaster infill, provide self-furring expanded-metal lath attached to door panel.

E. Latch and Lock Hardware:

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1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
2. Keys: Furnish two keys per lock and key all locks alike.
3. Mortise Cylinder Preparation: Where indicated, prepare door panel to accept cylinder specified in [Section 087100 "Door Hardware."][Section 087111 "Door Hardware (Descriptive Specification)."]

F. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

2.6 FINISHES

A. Comply with NAAMM/NOMMA AMP 500 for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: 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.

D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
2. Factory Finished: Apply manufacturer's standard baked-enamel or powder-coat finish immediately after cleaning and pretreating, with minimum dry-film thickness of 1 mil for topcoat.

    a. Color: [As indicated by manufacturer's designations][Match Architect's sample][As selected by Architect from full range of industry colors]<Insert color>.

E. Stainless Steel Finishes:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finish: ASTM A480/A480M No. 4 finish. Grind and polish surfaces to produce uniform finish, free of cross scratches.

    a. Run grain of directional finishes with long dimension of each piece.
    b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

3. Bright, Cold-Rolled, Unpolished Finish: ASTM A480/A480M No. 2B.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates 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 INSTALLATION OF ACCESS DOORS AND FRAMES

A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: [Owner will engage][Engage] a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated access door in accordance with NFPA 80, Section 5.2.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated access door indicating compliance with each item listed in [NFPA 80][and][NFPA 101].

3.4 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083113

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SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Service doors.
2. Insulated service doors.
3. Fire-rated service doors.
4. Fire-rated, insulated service doors.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports, door-opening framing, corner guards, and bollards.
2. [Section 099113 "Exterior Painting"][and][Section 099123 "Interior Painting"] for finish painting of factory-primed doors.
3. Section 111200 "Parking Control Equipment" for parking control equipment interlocked to overhead coiling doors.

1.2 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.

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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 [, including full vision window secured to slat].
2. Bottom bar [with sensor edge].
3. Guides.
4. Brackets.
5. Hood.
6. Locking device(s).
7. Include similar Samples of accessories involving color selection.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For [Installer][and][testing and inspecting agency].

1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
2. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.

B. Oversize Construction Certification: For door assemblies required to be fire-rated and that exceed size limitations of labeled assemblies.

C. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Special warranty.

B. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

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

1.5 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]<Insert number> hours' normal travel time from Installer's place of business to Project site.

B. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections

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of fire-rated door assemblies is to meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

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

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: [Two]<Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain overhead coiling doors from single source from single manufacturer.

1. Obtain operators and controls from overhead coiling-door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Complying with NFPA 80; listed and labeled by 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. Temperature-Rise Limit: [Where indicated][At exit enclosures and exit passageways], provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.
3. Smoke Control: [Where indicated][In corridors and smoke barriers], 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.

B. Sound-Control Doors: Assemblies tested in a laboratory for sound-transmission-loss performance according to ASTM E90, calculated according to ASTM E413, and rated for not less than the STC value indicated.

C. Accessibility Standard: Comply with applicable provisions in [the USDOJ's "2010 ADA

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Standards for Accessible Design"][the ABA standards of the Federal agency having jurisdiction][and][ICC A117.1]<Insert requirement>.

D. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:

1. Design Wind Load: [As indicated on Drawings][Uniform pressure (velocity pressure) of 20 lbf/sq. ft., acting inward and outward]<Insert loads>.
2. Testing: According to ASTM E330/E330M [or DASMA 108 for garage doors and complying with acceptance criteria of DASMA 108]<Insert requirement>.
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][uniform pressure (velocity pressure) of 20-lbf/sq. ft.]<Insert load> wind load, acting inward and outward.

E. Windborne-Debris Impact Resistance: Provide [glazed][and][impact-protective] overhead coiling doors that pass ASTM E1886 missile-impact and cyclic-pressure tests according to [ASTM E1996 for Wind Zone 1][ASTM E1996 for Wind Zone 2][ASTM E1996 for Wind Zone 3][ASTM E1996 for Wind Zone 4][or DASMA 115] for [basic][enhanced] protection.

1. Large-Missile Test: For overhead coiling doors located within [30 ft.]<Insert dimension> of grade.
2. Small-Missile Test: For overhead coiling doors located between 30 ft. and [60 ft.]<Insert dimension> above grade.

F. Seismic Performance: Overhead coiling doors are to withstand the effects of earthquake motions determined according to [ASCE/SEI 7]<Insert requirement>.

1. Component Importance Factor: [1.5][1.0].

2.3 DOOR ASSEMBLY

A. Overhead Coiling Door: Insulated service overhead coiling door formed with curtain of interlocking metal slats.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. C.H.I. Overhead Doors, Inc.
b. Clopay Building Products
c. Overhead Door Corporation
d. Raynor Garage Doors
e. Wayne Dalton; a division of Overhead Door Corporation

B. Operation Cycles: Door components and operators capable of operating for not less

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than 200,000 cycles. 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.

1. Include tamperproof cycle counter.

C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. at 15 and 25 mph when tested according to [ASTM E283][or][DASMA 105].

D. STC Rating: [26]<Insert value>.

E. Insulated Door Curtain R-Value: [4.5 deg F x h x sq. ft./Btu]<Insert value>.

F. Insulated Door Assembly U-Factor: [0.90 Btu/deg F x h x sq. ft.]<Insert value>.

G. Door Curtain Material: Aluminum.

H. Door Curtain Slats: Flat profile slats of 1-7/8-inch center-to-center height.

1. Insulated-Slat Interior Facing: Metal.
2. Gasket Seal. Manufacturer's standard continuous gaskets between slats.

I. Bottom Bar: Two angles, each not less than [1-1/2 by 1-1/2 by 1/8 inch thick]<Insert dimensions>; fabricated from aluminum extrusions and finished [to match door]<Insert requirement>.

J. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats.

K. Hood: Match curtain material and finish.

1. Shape: Square.
2. Mounting: Face of wall.

L. Locking Devices: Equip door with slide bolt for padlock.

1. Locking Device Assembly: Single-jamb side locking bars, operable from [inside with thumbturn][outside with cylinder][outside only, with cylinder][inside and outside with cylinders]<Insert requirement>.

M. Manual Door Operator: Chain-hoist operator.

1. Provide operator with through-wall shaft operation.
2. Provide operator with manufacturer's standard removable operating arm.

N. Electric Door Operator:

1. Emergency Manual Operation: Chain type.
2. Obstruction-Detection Device: Automatic [photoelectric sensor][electric sensor edge on bottom bar][pneumatic sensor edge on bottom bar][; self-monitoring type]<Insert type>.

a. Sensor Edge Bulb Color: Black.

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3. Control Station(s): [Interior mounted][Exterior mounted][Where indicated on Drawings]<Insert location>.
4. Other Equipment: [Audible and visual signals][Portable radio-control system]<Insert device>.

O. Curtain Accessories: Equip door with [smoke seals][weatherseals][astragal][push/pull handles][pull-down strap][pole hook][and][automatic-closing device]<Insert item>.

P. Door Finish:

1. Aluminum Finish: Anodized color as selected by Architect from full range of industry colors and color densities.
2. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
3. Factory Prime Finish: Manufacturer's standard color.
4. Stainless Steel Finish: ASTM A480/A480M No. 2B (bright, cold rolled).
5. Interior Curtain-Slat Facing: Finish as selected by Architect from manufacturer's full range.

2.4 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.

2.5 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 A653/A653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.
2. Stainless Steel Door Curtain Slats: ASTM A240/A240M or ASTM A666, Type 304; sheet thickness of 0.025 inch; and as required.
3. Aluminum Door Curtain Slats: ASTM B209 sheet or ASTM B221 extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; thickness of 0.050 inch; and as required.
4. Vision-Panel Glazing: Manufacturer's standard clear glazing, fabricated from transparent acrylic sheet or fire-protection-rated glass as required for type of door; set in glazing channel secured to curtain slats.
5. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84 or UL 723. Enclose insulation completely within slat faces.
6. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with

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[minimum steel thickness of 0.010 inch][and][minimum aluminum thickness of 0.032 inch].

7. Plastic Interior Curtain-Slat Facing: Extruded PVC plastic with maximum flame-spread index of [25][75][200] and smoke-developed index of 450, according to ASTM E84 or UL 723.

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].

C. Pass Door(s): Swinging-door and frame assembly constructed integrally with the coiling-door assembly [and bearing the same fire rating]. Comply with the accessibility standard of authorities having jurisdiction.

1. Door Frame and Integral Jamb Guide: Fabricate of 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.
2. Hinged Frame: Hinged pass door and frame that swings out of the way, as a unit, to allow use of the full coiling-door opening width. One jamb of the pass-door frame is hinged and the other jamb includes a guide for the lower, narrower part of the coiling-door curtain.
3. Rigid Frame: Rigid pass door and frame that are built into the rigid, lower part of the door curtain and that raise with the curtain.
4. Locking Hardware:

    a. [Lockset][Exit Hardware]: [As specified in Section 087100 "Door Hardware."][As specified in Section 087111 "Door Hardware (Descriptive Specification)."][As selected by Architect from manufacturer's full range.]<Insert requirement.>
    b. Lock Cylinders: As [specified in Section 087100 "Door Hardware"][specified in Section 087111 "Door Hardware (Descriptive Specification)"][standard with manufacturer][and keyed to building keying system].
    c. Keys: [Two][Three]<Insert number> for each cylinder.

5. Thresholds: Equip pass doors with integral thresholds that comply with the accessibility standard of authorities having jurisdiction.

2.6 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

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G90 zinc coating, complying with ASTM A653/A653M.

2. Stainless Steel: 0.025-inch- thick, stainless steel sheet, Type 304, complying with ASTM A240/A240M or ASTM A666.
3. Aluminum: 0.040-inch- thick aluminum sheet complying with ASTM B209, of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.
4. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.
5. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

B. Removable Metal Soffit: Formed or extruded from same metal and with same finish as curtain if hood is mounted above ceiling unless otherwise indicated.

2.7 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: As [specified in Section 087100 "Door Hardware"][specified in Section 087111 "Door Hardware (Descriptive Specification)"][standard with manufacturer][and keyed to building keying system].
2. Keys: [Two][Three]<Insert number> for each cylinder.

C. Chain Lock Keeper: Suitable for padlock.

D. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.8 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][nylon brushes]<Insert material>.

C. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable,

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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. Pull-Down Strap: Provide pull-down straps for doors more than 84 inches high.

F. Pole Hooks: Provide pole hooks and poles for doors more than 84 inches high.

G. Automatic-Closing Device: 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. [Testing for manually operated doors allows resetting by opening the door without retensioning the counterbalance mechanism][Release mechanism for motor-operated doors allows testing without mechanical release of the door.] Automatic-closing device is to be designed for activation by the following:

1. Replaceable fusible links with temperature rise and melting point of [165 deg F]<Insert temperature> 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.

2.9 COUNTERBALANCE 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.

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E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.10 MANUAL DOOR OPERATORS

A. General: Equip door with manual door operator by door manufacturer.

B. Push-up Door Operation: Lift handles and pull rope for raising and lowering doors, with counterbalance mechanism designed so that required lift or pull for door operation does not exceed [25 lbf]<Insert value>.

C. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum [25-lbf][30-lbf]<Insert value> force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

D. Crank Operator: Consisting of crank and crank gearbox, steel crank drive shaft, and gear-reduction unit, of type indicated. Size gears to require not more than [25-lbf][30-lbf]<Insert value> force to turn crank. Fabricate gearbox to be oiltight and to completely enclose operating mechanism. Provide manufacturer's standard crank-locking device.

2.11 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 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.

2.12 ALUMINUM FINISHES

A. Mill Finish: Manufacturer's standard.

B. Clear Anodic Finish: AAMA 611, [AA-M12C22A41, Class I, 0.018 mm][AA-M12C22A31, Class II, 0.010 mm] or thicker.

C. Color Anodic Finish: AAMA 611, [AA-M12C22A42/A44, Class I, 0.018 mm][AA-M12C22A32/A34, Class II, 0.010 mm] or thicker.

D. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

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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, GENERAL

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 the accessibility standard.

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 [automatic garage doors openers] according to UL 325.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: [Owner will engage][Engage] a qualified testing agency to perform tests and inspections and to furnish reports to Architect.

B. Perform the following tests and inspections [with the assistance of a factory-authorized service representative]:

1. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door

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assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in [NFPA 80][and][NFPA 101].

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.5 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.

3.6 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service includes [three][six][nine][12] months' full maintenance by skilled employees of coiling-door Installer. Include [monthly][quarterly] preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies are to 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.

3.7 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

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SECTION 083613 - SECTIONAL DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sectional-door assemblies.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.
2. [Section 099113 "Exterior Painting"][and][Section 099123 "Interior Painting"] for finish painting of factory-primed steel doors.
3. Section 111200 "Parking Control Equipment" for parking control equipment interlocked to sectional doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of sectional door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
2. For power-operated doors, include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: For each installation and for components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. 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. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.

D. Samples for Initial Selection: For units with factory-applied finishes.

1. Include Samples of accessories involving color selection.

E. Samples for Verification: For each type of exposed finish and for each color and texture required on the following components, in manufacturer's standard sizes:

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1. Glazing.
2. Metal for door sections.
3. Hardware.
4. <Insert requirements>.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranties: For manufacturer's warranty [and finish warranty].

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sectional doors to include in maintenance manuals.

B. Manufacturer's warranty.

C. Finish warranty.

1.5 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.

B. Regulatory Requirements: Comply with provisions in the [U.S. Department of Justice's "2010 ADA Standards for Accessible Design"][U.S. Department of Transportation's "ADA Standards for Transportation Facilities"][the United States Access Board's "Architectural Barriers Act (ABA) Standards"][41 CFR, Appendix A to Subpart 101-19.6, "Uniform Federal Accessibility Standards"][ICC A117.1]<Insert requirements> applicable to sectional doors.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of sectional doors 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. Failure of components or operators before reaching required number of operation cycles.
    c. Faulty operation of hardware.
    d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
    e. Delamination of exterior or interior facing materials.

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2. Warranty Period: [Two][Five]<Insert number> years from date of Substantial Completion.

B. Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: [10]<Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain sectional doors from single source from single manufacturer.

1. Obtain operators and controls from sectional door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Provide sectional doors that comply with performance requirements specified without failure from defective manufacture, fabrication, installation, or other defects in construction [and without requiring temporary installation of reinforcing components].

B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Design Wind Load: [As indicated on Drawings][Uniform pressure (velocity pressure) of 20 lbf/sq. ft., acting inward and outward]<Insert requirements>.
2. Testing: In accordance with ASTM E330/E330M [or DASMA 108 for garage doors and complying with DASMA 108 acceptance criteria]<Insert requirements>.
3. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.
    a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of door width.
    b. Deflection of horizontal track assembly shall not exceed 1/240 of door height.
4. Operability under Wind Load: Design sectional doors to remain operable under [design][uniform pressure (velocity pressure) of 20 lbf/sq. ft.][uniform pressure (velocity pressure) of 30 lbf/sq. ft.]<Insert load> wind load, acting inward and outward.

C. Windborne-Debris Impact Resistance: Provide sectional doors complying with the following requirements:

1. Glazed Openings: Pass ASTM E1886 Large Missile Test and cyclic-pressure

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tests in accordance with ASTM E1996 for [basic][enhanced] protection and Wind Zone [applicable to basic design wind speed indicated on Drawings]<Insert requirements>.

2. Garage-Door Glazed Openings: Pass DASMA 115.

D. Seismic Performance: Provide sectional doors that withstand the effects of earthquake motions determined in accordance with [ASCE/SEI 7]<Insert requirement>.

1. Component Importance Factor: [1.5][1.0]<Insert requirements>.

2.3 SECTIONAL-DOOR ASSEMBLY

A. Sectional Door: Provide [steel][aluminum] sectional door formed with hinged sections and fabricated so that finished door assembly is rigid and aligned with tight hairline joints; free of warp, twist, and deformation; and complies with requirements in DASMA 102.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. Clopay Building Products
b. Overhead Door Corporation
c. Raynor Garage Doors
d. Wayne Dalton; a division of Overhead Door Corporation

B. Operation Cycles: Door components and operators capable of operating for not less than 100,000 operation cycles. One operation cycle is complete when door is opened from closed position to the open position and returned to closed position.

C. Air Infiltration: Maximum rate of [0.4 cfm/sq. ft.]<Insert value> when tested in accordance with ASTM E283 or DASMA 105.

D. U-Value: 0.052 Btu/sq. ft. x h x deg F.

E. Steel Door Sections: ASTM A653/A653M, zinc-coated (galvanized), cold-rolled, commercial steel sheet with G60 zinc coating.

1. Door-Section Thickness: 2 inches.
2. Section Faces:

a. Thermal-Break Construction: Provide sections with continuous thermal-break construction separating the exterior and interior faces of door.
b. Exterior Face: Fabricated from single sheets, not more than [24 inches]<Insert dimension> high; with horizontal meeting edges rolled to continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove, weather- and pinch-resistant seals and reinforcing flange return.

1) Steel Sheet Thickness: [0.019-inch][0.022-inch][0.028-inch][0.040-

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inch][0.064-inch]<Insert dimension> nominal coated thickness.
2) Surface: Manufacturer's standard, flat.

c. Interior Face: Enclose insulation completely within steel exterior facing and interior facing material, with no exposed insulation. Provide the following interior-facing material:

1) Zinc-Coated (Galvanized) Steel Sheet: With minimum nominal coated thickness of 0.025 inch.
2) Plastic: [Manufacturer's standard vinyl material complying with DASMA 107 requirements]<Insert requirements>.

3. End Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet not less than 0.064-inch nominal coated thickness and welded to door section.
4. Intermediate Stiles: Provide intermediate stiles formed from not less than 0.064-inch- thick galvanized-steel sheet, cut to door section profile, and welded in place. Space stiles not more than [48 inches]<Insert requirements> apart.
5. Section Reinforcing: Horizontal and diagonal reinforcement as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place. [Ensure that reinforcement does not obstruct vision lites.]

a. Bottom Section: Reinforce section with a continuous channel or angle conforming to bottom-section profile [and allowing installation of astragal (weatherseal)].
b. Hardware Locations: Provide reinforcement for hardware attachment.

6. Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard [CFC-free] insulation of type indicated below:

a. Board Insulation: [Polystyrene][or][polyurethane], secured to exterior face sheet.
b. Foamed-in-Place Insulation: Polyurethane, foamed in place to completely fill interior of section and pressure bonded to face sheets to prevent delamination under wind load.
c. Fire-Resistance Characteristics: Maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, in accordance with ASTM E84.

F. Aluminum Sections: ASTM B221 extruded-aluminum stile and rail members of alloy and temper standard with manufacturer for type of use and finish indicated; [in minimum thickness required to comply with requirements]<Insert requirements>; with rail and stile dimensions and profiles indicated on Drawings; and with overlapped or interlocked weather- and pinch-resistant seal at meeting rails.

1. Door-Section Thickness: 2 inches.
2. Section Reinforcing: Continuous horizontal and diagonal reinforcement as required to stiffen door and for wind loading. Ensure that reinforcement does not obstruct vision lites.

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a. Hardware Locations: Provide reinforcement for hardware attachment.

3. Insulated Stiles and Rails: Fill stiles and rails [manufacturer's standard polyurethane expanding foam]<Insert requirements>.
4. Glazed Panels: Manufacturer's standard, aluminum-framed section with glazing sealed with glazing tape and [aluminum][matching vinyl]<Insert requirements> glazing bead. Glazing as follows:

    a. Float Glass: 3 mm thick and complying with ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
    b. Tempered Glass: 3 mm thick and complying with ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), Type I, Class 1 (clear), Quality-Q3.
    c. Insulating Glass Units: Manufacturers' standard unit with tempered glass lites complying with ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), Type I, Class 1 (clear), Quality-Q3.
    d. <Insert glazing requirements>.

5. Solid Aluminum Panels: ASTM B209, alloy and temper standard with manufacturer for use and finish indicated.

    a. Description: [0.050 inch thick][1/2-inch- thick overall insulated panel composed of 0.050-inch aluminum interior and exterior panels with an extruded polystyrene (EPS) core]<Insert requirements>.
    b. Attachment to Frame: Sealed with glazing tape and aluminum glazing bead.
    c. Aluminum Surface: Smooth.

6. Perforated Aluminum Panels: ASTM B209, alloy and temper standard with manufacturer for use and finish indicated.

    a. Description: [0.50 inch thick, with mill finish, 0.312-inch square perforations on 0.5-inch centers, and a total open area of 39 percent]<Insert requirements>.
    b. Attachment to Frame: Sealed with glazing tape and aluminum glazing bead.

7. <Insert panel requirements>.

G. Track: Manufacturer's standard, galvanized-steel, high-lift track system. Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides.

1. Material: Galvanized steel, ASTM A653/A653M, minimum G60 zinc coating.
2. Size: As recommended in writing by manufacturer for door size, weight, track configuration and door clearances indicated on Drawings.
3. Track Reinforcement and Supports: Provide galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches apart for door-drop safety device.

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a. Vertical Track: Incline vertical track to ensure weathertight closure at jambs. Provide [continuous angle][continuous reverse angle][intermittent jamb brackets]<Insert requirements> attached to track and wall.
b. Horizontal Track: Provide continuous reinforcing angle from curve in track to end of track, attached to track and supported at points by laterally braced attachments to overhead structural members.

H. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom [top][and][jambs] of door. [Provide combination bottom weatherseal and sensor edge for bottom seal.]

I. Windows: Manufacturer's standard window units of shape and size and in locations indicated on Drawings. Set glazing in vinyl, rubber, or neoprene glazing channel. Provide removable stops of same material as door-section frames. Provide the following glazing:

1. Clear Float Glass: 3 mm thick and complying with ASTM C1036, Type I, Class 1, Quality-Q3.
2. Clear Acrylic Plastic: 3 mm thick, transparent, smooth or polished, and formulated to be UV resistant. [Provide double insulating units.]
3. Clear Polycarbonate Plastic: 3 mm thick, transparent, fire-retardant, UV-resistant, polycarbonate sheet manufactured by extrusion process.
4. Insulating Glass Units: [Manufacturer's standard]<Insert description>.
5. <Insert glazing requirements>.

J. Pass Door: Provide manufacturer's standard pass door in size and location indicated on Drawings; complete with glazing, operating hardware, and mortise lock; and with welded frame, exterior matching door face, and integral shiplap weather seal.

1. Hinges: [Manufacturer's standard geared hinges]<Insert requirements>.
2. Door Closer: [Manufacturer's standard pneumatic closer sized for swing door and mounted on interior]<Insert requirements>.
3. Lock Cylinders: Cylinders complying with Section 087100 "Door Hardware" requirements.

a. Keying: [Keyed to building keying system]<Insert requirements>.
b. Keys: Two for each cylinder.

4. Features:

a. Rain Cap: To protect door from accumulated water.
b. Vision Lite: <Insert requirements>.
c. <Insert feature>.

K. Exhaust Port: [Manufacturer's standard, installed in bottom section in location indicated on Drawings]<Insert requirements>.

L. Hardware: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless steel, or other corrosion-resistant fasteners, to suit door type.

1. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch nominal

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coated thickness at each end stile and at each intermediate stile, in accordance with manufacturer's written recommendations for door size.

a. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible.
b. Provide double-end hinges where required for doors more than 16 ft. wide unless otherwise recommended by door manufacturer in writing.

2. Rollers: Heavy-duty rollers with steel ball bearings in case-hardened steel races, mounted to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Match roller-tire diameter to track width.

a. Roller-Tire Material: [Case-hardened steel][Neoprene or bronze][Manufacturer's standard]<Insert requirements>.

3. Push/Pull Handles: Equip each door with galvanized-steel lifting handles on each side of door, finished to match door.
4. Mail Slot: [Manufacturer's standard; brushed aluminum]<Insert requirements>.
5. <Insert hardware requirements>.

M. Locking Device:

1. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.
2. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded deadbolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

a. Lock Cylinders: Cylinders complying with Section 087100 "Door Hardware" requirements.
b. Keying: [Keyed to building keying system]<Insert requirements>.
c. Keys: Two for each cylinder.

3. Chain Lock Keeper: Suitable for padlock.
4. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

N. Counterbalance Mechanism:

1. Torsion Spring: Adjustable-tension torsion springs complying with requirements of DASMA 102 for number of operation cycles indicated, mounted on torsion shaft.
2. Cable Drums and Shaft for Doors: Cast-aluminum cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised.

a. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft.
b. Provide one additional midpoint bracket for shafts up to 16 ft. long and two additional brackets at one-third points to support shafts more than 16 ft. long unless closer spacing is recommended in writing by door

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manufacturer.

3. Cables: Galvanized-steel, multistrand, lifting cables with cable safety factor of at least [5 to 1][7 to 1]<Insert requirements>.
4. Cable Safety Device: Include a spring-loaded steel or bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if lifting cable breaks.
5. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
6. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.
7. <Insert requirements>.

O. Manual Door Operator:

1. Push-Up Operation: Lift handles and pull rope for raising and lowering doors located on inside and outside of bottom section; with counterbalance mechanism designed so that required lift or pull for door operation does not exceed [25 lbf]<Insert value>.
2. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum [25 lbf][35 lbf]<Insert value> force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

P. Electric Door Operator: Electric door operator assembly of size and capacity recommended by door manufacturer for door and operation cycles 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.
3. Safety: Listed in accordance with UL 325 by a qualified testing agency for commercial or industrial use [; moving parts of operator enclosed or guarded if exposed and mounted at 8 ft. or lower]<Insert requirements>.
4. Usage Classification: Heavy duty, 25 or more cycles per hour and more than 90 cycles per day.
5. Operator Type: Manufacturer's standard for door requirements As indicated on Drawings.
6. Motor: Reversible-type [with controller (disconnect switch)] for [interior, clean, and dry][exterior, dusty, wet, or humid]<Insert requirements> motor exposure. Use adjustable motor-mounting bases for belt-driven operators.

    a. Motor Size: As required 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.
    b. Electrical Characteristics:

        1) Phase: Single phase.

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2) Volts: 115 V.

7. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
8. Obstruction Detection: Automatic external entrapment protection consisting of automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.

    a. Monitored Entrapment Protection: [Photoelectric sensor][Electric sensor edge on bottom section] designed to interface with door-operator control circuit to detect damage to or disconnection of sensor and complying with requirements in UL 325.
    b. Unmonitored Entrapment Protection: [Pneumatic sensor edge, black, located within weatherseal mounted to bottom bar][Retro-reflective photo sensor]<Insert requirements>.

9. Control Station: Surface mounted, two-position (open and close) control.

    a. Operation: Push button interior and key exterior.
    b. Interior-Mounted Unit: Full-guarded, surface-mounted, [heavy-duty type, with general-purpose NEMA ICS 6, Type 1][standard-duty, weatherproof-type, NEMA ICS 6, Type 4]<Insert requirements> enclosure.
    c. Exterior-Mounted Unit: Full-guarded, surface-mounted, [standard-duty, weatherproof type, NEMA ICS 6, Type 4]<Insert requirements> enclosure.
    d. Features: Provide the following:

        1) Vehicle detection operation.
        2) Radio-control operation.
        3) Card-reader control.
        4) Photocell operation.
        5) Door-timer operation.
        6) Explosion- and dust-ignition-proof control wiring.
        7) Audible and visual signals that comply with regulatory requirements for accessibility.
        8) <Insert requirements>.

10. Emergency Manual Operation: Chain type designed so required force for door operation does not exceed 25 lbf.
11. Emergency Operation Disconnect Device: 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.
12. Motor Removal: Design operator so motor can be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

Q. Metal Finish: Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating

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finishes.

1. Factory Prime Steel Finish: Compatible with field-applied finish and in manufacturer's standard color. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.
2. 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.

    a. Aluminum Finish: Comply with [AAMA 2603][AAMA 2604] requirements for pigmented organic coatings applied to aluminum extrusions and panels.
    b. Color and Gloss: As selected by Architect from manufacturer's full range.

3. Anodized Aluminum Finish: 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.

    a. Clear Anodic Finish: AAMA 611, [AA-M12C22A41, Class I, 0.018 mm][AA-M12C22A31, Class II, 0.010 mm] or thicker.
    b. Color Anodic Finish: AAMA 611, [AA-M12C22A42/A44, Class I, 0.018 mm][AA-M12C22A32/A34, Class II, 0.010 mm] or thicker.

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

4. High-Performance, Organic, Aluminum Finish (Two-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Conversion coating; Organic Coating: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than [50][70] percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with [AAMA 2604][AAMA 2605] and with coating and resin manufacturers' written instructions.

    a. Color and Gloss: As selected by Architect from manufacturer's full range of industry colors and color densities.

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

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3.2 INSTALLATION

A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; in accordance with manufacturer's written instructions.

B. Tracks:

1. Fasten vertical track assembly to opening jambs and framing with fasteners spaced not more than 24 inches apart.
2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

D. Power-Operated Doors: Install [automatic garage doors openers] in accordance with UL 325.

3.3 STARTUP SERVICES

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.

D. Touchup Painting Galvanized Material: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A780/A780M.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

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SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed entrance and storefront systems.

B. Related Requirements:

1. Section 014339 "Mockups" for preconstruction laboratory mockup testing.
2. Section 084126 "All-Glass Entrances and Storefronts" for systems without aluminum support framing.
3. Section 081116.13 "Interior Aluminum Doors and Frames" for interior aluminum framing.

1.2 ALLOWANCES

A. See Section 012100 "Allowances" for description of allowances affecting items specified in this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]<Insert location>.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings:

1. Plans, elevations, sections, full-size details, and attachments to other work.
2. Details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
3. Full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrance and storefront systems, showing the following:

a. Joinery, including concealed welds.
b. Anchorage.

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c. Expansion provisions.
d. Glazing.
e. Flashing and drainage.

4. Connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
5. Point-to-point wiring diagrams showing the following:

a. Power requirements for each electrically operated door hardware.
b. Location and types of switches, signal device, conduit sizes, and number and size of wires.

6. <Insert requirements>.
7. Signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

D. Samples for Verification: Actual sample of finished products for each type of exposed finish.

1. Size: [Manufacturers' standard size]<Insert size>.

E. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

F. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

G. Delegated Design Submittals: For aluminum-framed entrances and storefront systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

H. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party-Certified Life-Cycle Assessment: For each product.

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1.5 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: For aluminum-framed entrance and storefront systems, accessories, and components, from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront system.

B. Product Test Reports: For aluminum-framed entrance and storefront systems, for tests performed by [a qualified testing agency][manufacturer and witnessed by a qualified testing agency].

C. Preconstruction Test Reports: For aluminum-framed entrance and storefront systems.

1. Testing Program: Developed specifically for Project.
2. Test Reports: Prepared by a qualified preconstruction testing agency for each preconstruction test.
3. Record Drawings: As-built drawings of preconstruction laboratory mockups showing changes made during preconstruction laboratory mockup testing.

D. Source Quality-Control Reports: For aluminum-framed entrance and storefront systems.

E. Field Quality-Control Reports: For aluminum-framed entrance and storefront systems.

F. Quality-Control Program: Developed specifically for Project, including fabrication and installation, in accordance with recommendations in ASTM C1401. Include periodic quality-control reports.

G. Qualification Statements:

1. For Installer [and laboratory mockup preconstruction testing agency][and field testing agency][and egress door inspector].

H. Delegated Design Engineer Qualifications: For aluminum-framed entrance and storefront systems.

I. Sample Warranties: For aluminum-framed entrance and storefront systems.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For aluminum-framed entrance and storefront systems.

B. Maintenance Data for Structural Sealant: For structural-sealant-glazed storefront. Include ASTM C1401 recommendations for post-installation-phase quality-control program.

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1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Fabricator of products.
2. Entity that employs installers and supervisors who are trained and approved by manufacturer.
3. Authorized representative who is trained and approved by manufacturer.
4. Entity that is certified under the North American Contractor Certification Program (NACC) and that employs installers and supervisors who are trained and approved by manufacturer [and who are certified under the Architectural Glass and Metal Technician (AGMT) certification program].

B. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in [state]<Insert jurisdiction> where Project is located and who is experienced in providing engineering services of the type indicated.

C. Laboratory Mockup Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated [and accredited by the International Accreditation Service or the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement as complying with ISO/IEC 17025].

D. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated [and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025] and acceptable to Owner and Architect.

E. Egress Door Inspector Qualifications:

1. Inspector for field quality-control inspections of egress door assemblies to comply with qualifications set forth in NFPA 101, Ch. 7 "Means of Egress," Section "Means of Egress Components," Article "Inspection of Door Openings."
2. Inspector for field quality-control inspections of egress door assemblies to be certified under DHI's certification program as a Fire and Egress Door Assembly Inspector (FDAI) or a Certified Fire and Egress Door Assembly Inspector (CFDAI).

F. 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.

G. Structural-Sealant Glazing: Comply with ASTM C1401 for design and installation of storefront systems that include structural glazing.

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1.8 MOCKUPS

A. Build mockups [to verify selections made under Sample submittals][to demonstrate aesthetic effects][to set quality standards for materials and execution][to set quality standards for fabrication and installation].

1. Build mockup [as indicated on Drawings]<Insert mockup requirements>.
2. Testing to be performed on mockups in accordance with requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: [Owner will engage][Engage] a qualified testing agency to perform preconstruction testing on laboratory mockups.

1. Build preconstruction laboratory mockups at testing agency facility; use personnel, products, and methods of construction that will be used at Project site.
2. Size and Configuration: As indicated on Drawings.
3. Notify Architect [seven]<Insert number> days in advance of the dates and times when preconstruction laboratory mockups will be constructed and tested.

B. Preconstruction Laboratory Mockup Testing: Performed by a qualified testing agency on manufacturer's standard assemblies.

1. Test preconstruction laboratory mockups in accordance with requirements in "Performance Requirements" Article. Perform the following tests in the following order:

a. Structural, 50 Percent: ASTM E330/E330M at 50 percent of positive test load.
b. Air Leakage: ASTM E283.
c. Water Penetration under Static Pressure: ASTM E331.
d. Water Penetration under Dynamic Pressure: AAMA 501.1.
e. Thermal Cycling: AAMA 501.5. Repeat the following:

1) Air Leakage: ASTM E283.
2) Water Penetration under Static Pressure: ASTM E331.

f. Structural, 100 Percent: ASTM E330/E330M at 100 percent of positive and negative test loads. Repeat the following:

1) Air Leakage: ASTM E283.
2) Water Penetration under Static Pressure: ASTM E331.
3) Water Penetration under Dynamic Pressure: AAMA 501.1.

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g. Structural, 150 Percent: ASTM E330/E330M at 150 percent of positive and negative test loads.

C. Preconstruction Adhesion and Compatibility Testing: Submit to structural glazing sealant manufacturer, for testing indicated below, Samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that is in close proximity to or is touching the structural or nonstructural sealants of a structural glazed system.

1. Compatibility: Test materials or components using ASTM C1087.
2. Adhesion: Test for adhesion or lack of adhesion of a structural sealant to the surface of another material or component using ASTM C1135.
3. Submit no fewer than [eight]<Insert number> pieces of each type of material, including joint substrates, shims, joint-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, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
6. Testing will not be required if data based on previous testing of current sealant products match those submitted.

1.10 WARRANTY

A. Special Warranty: [Manufacturer agrees][Installer agrees][Manufacturer and Installer agree] to repair or replace components of aluminum-framed entrance and storefront systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including <Insert type of failure>.
b. Faulty operation of <Insert components>.
c. Deterioration of metals [, metal finishes,] and other materials beyond normal [weathering][use].
d. <Insert conditions relating to specified products>.
e. <Insert failure modes>.

2. Warranty Period: [Two][Five][10]<Insert number> years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: 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 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.

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c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: [Five][10][20]<Insert number> years from date of Substantial Completion.

C. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D 4214.
c. Cracking, peeling, or chipping.

2. Warranty Period: [Five][10]<Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain all components of aluminum-framed entrance and storefront system, including framing [spandrel panels][venting windows] and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrance and storefront systems.

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

1. Aluminum-framed entrance and storefront systems to withstand movements of supporting structure, including, but not limited to, 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.

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C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: [As indicated on Drawings]<Insert loads>.

D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:

1. Deflection Normal to Wall Plane: Limited to [1/175 of length of span of the framing member for lengths of up to 13 feet 6 inches and to 1/240 of length of span of the framing member plus 1/4 inch for lengths greater than 13 feet 6 inches]<Insert deflection limit>.
2. Deflection Parallel to Glazing Plane: Limited to [amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch]<Insert deflection limit>.

    a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.

E. Structural: Test in accordance with ASTM E330/E330M as follows:

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

F. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than [6.24 lbf/sq. ft.][10 lbf/sq. ft.][15 lbf/sq. ft.]<Insert value>.

G. Water Penetration under Dynamic Pressure: Test in accordance with 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.][10 lbf/sq. ft.][15 lbf/sq. ft.]<Insert value>.
2. Maximum Water Leakage: [In accordance with AAMA 501.1][No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation]. Water leakage does not include water controlled by flashing and gutters, or water that is drained

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to exterior.

H. Seismic Performance: Aluminum-framed entrance and storefront systems to withstand the effects of earthquake motions determined in accordance with [ASCE/SEI 7]<Insert requirement>.

1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.6 at design displacement [and 1.5 times the design displacement].

I. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):

a. Fixed Glazing and Framing Areas: U-factor for the system of not more than [0.41 Btu/sq. ft. x h x deg F][0.45 Btu/sq. ft. x h x deg F][0.57 Btu/sq. ft. x h x deg F][0.69 Btu/sq. ft. x h x deg F]<Insert value> as determined in accordance with NFRC 100.
b. Entrance Doors: U-factor of not more than [0.68 Btu/sq. ft. x h x deg F][0.77 Btu/sq. ft. x h x deg F][0.83 Btu/sq. ft. x h x deg F][1.10 Btu/sq. ft. x h x deg F]<Insert value> as determined in accordance with NFRC 100.
c. Venting Windows: Whole window U-factor of not more than [0.37 Btu/sq. ft. x h x deg F][0.43 Btu/sq. ft. x h x deg F][0.45 Btu/sq. ft. x h x deg F][0.60 Btu/sq. ft. x h x deg F][0.65 Btu/sq. ft. x h x deg F]<Insert value> as determined in accordance with NFRC 100.

2. Solar Heat-Gain Coefficient (SHGC):

a. Fixed Glazing and Framing Areas: SHGC for the system of not more than [0.26][0.35][0.40][0.45]<Insert value> as determined in accordance with NFRC 200.
b. Entrance Doors: SHGC of not more than [0.22][0.25][0.35][0.40][0.45]<Insert value> as determined in accordance with NFRC 200.
c. Venting Windows: Whole window SHGC of not more than [0.22][0.27][0.30][0.40]<Insert value> as determined in accordance with NFRC 200.

3. Air Leakage:

a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than [0.06 cfm/sq. ft.]<Insert value> at a static-air-pressure differential of [1.57 lbf/sq. ft.][6.24 lbf/sq. ft.]<Insert value> when tested in accordance with ASTM E283.
b. Entrance Doors: Air leakage of not more than [1.0 cfm/sq. ft.]<Insert value> at a static-air-pressure differential of 1.57 lbf/sq. ft..
c. Venting Windows: Whole window air leakage of not more than [0.3 cfm/sq. ft.]<Insert value> at a static-air-pressure differential of [6.24 lbf/sq. ft.]<Insert value> when tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440.

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4. Condensation Resistance Factor (CRF):

    a. Fixed Glazing and Framing Areas: CRF for the system of not less than [35][55][70]<Insert value> as determined in accordance with AAMA 1503.
    b. Entrance Doors: CRF of not less than [57][63][68]<Insert value> as determined in accordance with AAMA 1503.
    c. Venting Windows: Whole window CRF of not less than [45][52][55]<Insert value> as determined in accordance with AAMA 1503.

J. Noise Reduction: Test in accordance with ASTM E90, with ratings determined by ASTM E1332, as follows.

1. Outdoor-Indoor Transmission Class: Minimum [26][30][34]<Insert number>.

K. Blast Resistance:

1. Hazard Rating: [No Break][No Hazard][Minimal Hazard][Very Low Hazard][Low Hazard][Moderate Hazard][High Hazard] in accordance with ASTM F2912, tested in accordance with ASTM F1642/F1642M.

L. Performance Condition: [1][2][3a][3b][4][5] in accordance with GSA-TS01.

M. Ballistic Resistance, UL 752: [Listed and labeled as][Level 1][Level 2][Level 3][Level 4][Level 5][Level 6][Level 7][Level 8][Level 9][Level 10][Level 1-SG][Level 2-SG][Level 3-SG][Level 4-SG][Level 5-SG][Level 6-SG][Level 7-SG][Level 8-SG][Level 9-SG][Level 10-SG] when tested in accordance with UL 752.

N. Ballistic Resistance, ASTM F1233: [Class/Level HG1][Class/Level HG2][Class/Level HG3][Class/Level HG4][Class/Level SMG][Class/Level R1][Class/Level R2][Class/Level R3][Class/Level R4-AP][Class/Level R5][Class/Level SH1][Class/Level SH2] when tested in accordance with ASTM F1233.

O. Ballistic Resistance, HPW-TP-0500.03: [A][B][C][D][E] when tested in accordance with HPW-TP-0500.03.

P. Ballistic Resistance, SD-STD-01.01: [R][SH] when tested in accordance with SD-STD-01.01.

Q. Ballistic Resistance, NIJ STD-0108.01: [Level I][Level IIA][Level II][Level IIIA][Level III][Level IV] when tested in accordance with NIJ STD-0108.01.

R. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone [1][2][3][4] for [basic][enhanced] protection.

1. Large-Missile Test: For glazing located within [30 feet]<Insert dimension> of grade.
2. Small-Missile Test: For glazing located between 30 feet and [60 feet]<Insert dimension> above grade.

S. Thermal Movements: Allow for thermal movements resulting from ambient and surface

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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 in accordance with AAMA 501.5.

    a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of [180 deg F]<Insert temperature>.
    b. Low Exterior Ambient-Air Temperature: [0 deg F]<Insert temperature>.
    c. Interior Ambient-Air Temperature: [75 deg F]<Insert temperature>.

T. Structural-Sealant Joints:

1. Designed to carry gravity loads of glazing.

U. Structural Sealant: ASTM C1184. Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed, aluminum-framed entrance and storefront systems without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant to 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.

2.3 ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS

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

1. EFCO Corporation; Architectural Metals; Apogee Enterprises, Inc.
2. Kawneer Company, Inc.; Arconic Corporation
3. YKK AP America Inc.

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction: Thermally broken.
2. Interior Vestibule Framing Construction: Nonthermal.
3. Glazing System: Retained mechanically with gaskets on two sides and structural sealant on two sides.
4. Glazing Plane: [Front]<Insert location>.
5. Finish: [Clear anodic finish][Color anodic finish][Baked-enamel or powder-coat finish][High-performance organic finish][Superior-performance organic finish].
6. Fabrication Method: Field-fabricated stick system.
7. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
8. Steel Reinforcement: As required by manufacturer.

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C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

E. Insulated Spandrel Panels:

1. Comply with Section 074213.19 "Insulated Metal Wall Panels."
2. Laminated, metal-faced flat panels with no deviations in plane exceeding 0.8 percent of panel dimension in width or length.

a. Overall Panel Thickness: [As indicated][1 inch]<Insert thickness>.
b. Exterior Skin: Aluminum.

1) Thickness: [Manufacturer's standard for finish and texture indicated]<Insert thickness>.
2) Finish: [Match framing system]<Insert finish>.
3) Texture: Smooth.
4) Backing Sheet: 0.125-inch- thick, corrugated, high-density polyethylene.

c. Interior Skin: Aluminum.

1) Thickness: [Manufacturer's standard for finish and texture indicated]<Insert thickness>.
2) Finish: Matching storefront framing.
3) Texture: Smooth.
4) Backing Sheet: 0.125-inch- thick, corrugated, high-density polyethylene.

d. Thermal Insulation Core: Manufacturer's standard rigid, closed-cell, polyisocyanurate board.
e. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1) Flame-Spread Index: [25]<Insert value> or less.
2) Smoke-Developed Index: 50 or less.

F. Venting Windows:

1. As specified in Section 085113 "Aluminum Windows."
2. Manufacturer's standard units, complying with AAMA/WDMA/CSA 101/I.S.2/A440, with self-flashing mounting fins, and as follows:

a. Window Type: As indicated on Drawings.
b. Minimum Performance Class: [CW][AW]<Insert class>.
c. Minimum Performance Grade: As indicated on Drawings.
d. Hardware: Manufacturer's standard; of aluminum, stainless steel, die-cast steel, malleable iron, or bronze; including the following:

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1) Cam handle locking system.
2) Multi-point locking system.
3) Pole-operated, cam handle locking system, where rail is more than 72 inches above floor.
4) Rotary operator.
5) Steel or bronze operating arms.
6) Limit Devices: [Concealed friction adjustor and adjustable stay bar]<Insert type> limit devices designed to restrict sash opening.

a) Limit clear opening to [4 inches]<Insert dimension> for ventilation; with custodial key release.

e. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.
f. Insect Screens: Provide removable insect screen on each operable exterior sash, with screen frame finished to match window unit, complying with SMA 1004 or SMA 1201, and as follows:

1) Aluminum Wire Fabric: 18-by-18, 0.0445-inch-by-0.0445-inch; 18-by-16, 0.0445-inch-by-0.0515-inch; or 18-by-14, 0.0445-inch-by-0.0624-inch mesh of 0.013-inch- diameter, coated aluminum wire.
2) Glass-Fiber Mesh Fabric: 18-by-16 0.0445-inch-by-0.0515-inch or 18-by-14 0.0445-inch-by-0.0624-inch mesh of PVC-coated, glass-fiber threads, woven and fused to form a fabric mesh; complying with ASTM D3656/D3656M.
3) Fabric: Manufacturer's standard aluminum wire fabric or glass-fiber mesh fabric.

g. Glazing: [Same as adjacent aluminum-framed entrances and storefront glazing]<Insert glazing>.
h. Finish: [Match adjacent aluminum-framed entrances and storefront finish]<Insert finish>.

G. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

a. Thermal Construction: [High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior]<Insert description>.

2. Door Design: As indicated.
3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

a. Provide nonremovable glazing stops on outside of door.

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4. Finish: Match adjacent storefront framing finish.

2.4 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

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

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
3. Opening-Force Requirements:

a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion [and not more than 15 lbf to open the door to its minimum required width].
b. Accessible Interior Doors: Not more than 5 lbf to fully open door.

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

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

D. Pivot Hinges: BHMA A156.4, Grade 1.

1. Offset-Pivot Hinges: Provide top, bottom, and intermediate offset pivots at each door leaf.

E. Butt Hinges: BHMA A156.1, Grade 1, radius corner.

1. Nonremovable Pins: Provide setscrew in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.
2. Exterior Hinges: Stainless steel, with stainless steel pin.
3. Quantities:

a. For doors up to [87 inches]<Insert dimension> high, provide three hinges per leaf.
b. For doors more than [87 and up to 120 inches]<Insert dimensions> high, provide four hinges per leaf.

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F. Continuous-Gear Hinges: BHMA A156.26.

G. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.

H. Manual Flush Bolts: BHMA A156.16, Grade 1.

I. Automatic and Self-Latching Flush Bolts: BHMA A156.3, Grade 1.

J. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing in accordance with UL 305.

K. Cylinders:

1. As specified in Section 087100 "Door Hardware."
2. BHMA A156.5, Grade 1.

a. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation ["DO NOT DUPLICATE"][to be furnished by Owner].

L. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

M. Operating Trim: BHMA A156.6.

N. Removable Mullions: BHMA A156.3 extruded aluminum.

1. When used with panic exit devices, provide [keyed] removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing in accordance with UL 305. Use only mullions that have been tested with exit devices to be used.

O. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.

P. Concealed Overhead Holders and Stops: BHMA A156.8, Grade 1.

Q. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.

R. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

S. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

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T. Thresholds: BHMA A156.21 raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch.

U. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

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.][Comply with Section 088000 "Glazing."]

C. Glazing Sealants: [As recommended by manufacturer.][Comply with Section 088000 "Glazing."]

D. Structural Glazing Sealants: ASTM C1184 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 storefront system indicated.

1. Color: [Black][Gray][As selected by Architect from manufacturer's full range of colors]<Insert color>.

E. Weatherseal Sealants: ASTM C920 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 storefront manufacturers for this use.

1. Color: Match structural sealant.

2.6 MATERIALS

A. Sheet and Plate: ASTM B209.

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.

C. Structural Profiles: ASTM B308/B308M.

D. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface

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preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

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

2.7 ACCESSORIES

A. Automatic Door Operators: [Section 087113 "Power Door Operators."][Section 084229.33 "Swinging Automatic Entrances."]

B. 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][, fabricated from 300 series stainless steel].

C. Anchors: Three-way adjustable anchors with minimum adjustment of [1 inch]<Insert dimension> 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 A123/A123M or ASTM A153/A153M requirements.

D. Concealed Flashing: [Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials][Dead-soft, 0.018-inch- thick stainless steel, complying with ASTM A240/A240M, of type recommended by manufacturer].

E. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.

F. Rigid PVC filler.

2.8 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:

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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][interior][interior for vision glass and exterior for spandrel glazing or metal panels].
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.

F. Storefront Framing: Fabricate components for assembly using [shear-block system][screw-spline system][head-and-sill-receptor system with shear blocks at intermediate horizontal members]<Insert system>.

G. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At interior and exterior doors, provide compression weather stripping at fixed stops.

H. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

I. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

J. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.9 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, [AA-M12C22A41, Class I, 0.018 mm][AA-M12C22A31, Class II, 0.010 mm] or thicker.

B. Color Anodic Finish: AAMA 611, [AA-M12C22A42/A44, Class I, 0.018 mm][AA-M12C22A32/A34, Class II, 0.010 mm] or thicker.

1. Color: As selected by Architect from full range of industry colors and color densities.

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C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

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

D. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with [AAMA 2604][AAMA 2605] and containing not less than [50][70] percent PVDF resin by weight in color coat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
2. Color and Gloss: As selected by Architect from manufacturer's full range.

E. Superior-Performance Organic Finish, Three-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
2. Color and Gloss: As selected by Architect from manufacturer's full range.

F. Superior-Performance Organic Finish, Four-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
2. Color and Gloss: As selected by Architect from manufacturer's full range.

G. Superior-Performance Organic Finish, Single-Coat FEVE: Fluoropolymer finish complying with AAMA 2605.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color and Gloss: As selected by Architect from manufacturer's full range.

H. Superior-Performance Organic Finish, Two-Coat FEVE: Fluoropolymer finish complying with AAMA 2605.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
2. Color and Gloss: As selected by Architect from manufacturer's full range.

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2.10 SOURCE QUALITY CONTROL

A. Structural Sealant: Perform quality-control procedures complying with ASTM C1401 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 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Seal perimeter and other joints watertight unless otherwise indicated.

G. Metal Protection:

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

H. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.

I. Install joint filler behind sealant as recommended by sealant manufacturer.

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

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

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L. Install entrance doors to produce smooth operation and tight fit at contact points.

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

M. Install glazing as specified in Section 088000 "Glazing."

N. Install structural glazing as follows:

1. Prepare surfaces that will contact structural sealant in accordance with sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
2. Set glazing into framing in accordance with sealant manufacturer and framing manufacturer's written instructions and standard practice. Use a spacer or backer as recommended by manufacturer.
3. Set glazing with proper orientation so that coatings face exterior or interior as specified.
4. Hold glazing in place using temporary retainers of type and spacing recommended by manufacturer, until structural sealant joint has cured.
5. Apply structural sealant to completely fill cavity, in accordance with sealant manufacturer and framing manufacturer's written instructions and in compliance with local codes.
6. Apply structural sealant at temperatures indicated by sealant manufacturer for type of sealant.
7. Allow structural sealant to cure in accordance with manufacturer's written instructions.
8. Clean and protect glass as indicated in Section 088000 "Glazing."
9. After structural sealant has completely cured, remove temporary retainers and insert backer rod between lites of glass as recommended by sealant manufacturer.
10. Install weatherseal sealant to completely fill cavity, in accordance with sealant manufacturer's written instructions, to produce weatherproof joints.

3.3 ERECTION TOLERANCES

A. Install aluminum-framed entrance and storefront systems 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

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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.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: [Owner will engage][Engage] a qualified testing agency to perform tests.

B. Tests: Perform the following tests on [representative areas of aluminum-framed entrance and storefront systems][mockups]<Insert requirements>.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect to be tested in accordance with AAMA 501.2 and to not evidence water penetration.

    a. Perform a minimum of [two][three]<Insert number> 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 [10, 35, and 70 percent completion]<Insert requirements>.

2. Air Leakage: ASTM E783 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][three]<Insert number> 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 [10, 35, and 70 percent completion]<Insert requirements>.

3. Water Penetration: ASTM E1105 at a minimum [uniform][and][cyclic] 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 to not evidence water penetration.
4. Structural-Sealant Adhesion: Test structural sealant in accordance with recommendations in ASTM C1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.

    a. Test a minimum of [two][four][six]<Insert number> areas on each building facade.
    b. Repair installation areas damaged by testing.

C. Inspection Agency: [Owner will engage][Engage] a qualified inspector to perform inspections.

D. Inspections:

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1. Egress Door Inspections: Inspect each aluminum-framed entrance door equipped with panic hardware, located in an exit enclosure, electrically controlled, and equipped with special locking arrangements, in accordance with NFPA 101, Ch. 7 "Means of Egress," Section "Means of Egress Components," Article "Inspection of Door Openings."

E. Aluminum-framed entrance and storefront systems will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.5 MAINTENANCE SERVICE

A. Entrance Door Hardware Maintenance:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
2. Initial Maintenance Service: Beginning at Substantial Completion, provide [six]<Insert number> months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Use parts and supplies that are the same as those used in the manufacture and installation of original equipment.

3.6 ENTRANCE DOOR HARDWARE SETS

A. <Insert schedule>.

END OF SECTION 084113

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SECTION 085113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum windows.

1.2 COORDINATION

A. Finish Matching: Coordinate all exposed exterior aluminum components and trim to ensure uniform and consistent color and appearance. Use products specified in as a benchmark. Architect's decision will be final as to whether a proposed product matches.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review and discuss finishing of aluminum windows that is required to be coordinated with finishing of other aluminum work for color and finish matching.
3. Review, discuss, and coordinate interrelationship of aluminum windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
4. Review and discuss sequence of work required to construct a watertight and weathertight exterior building envelope.
5. Inspect and discuss condition of substrate and other preparatory work performed by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes.

B. Shop Drawings:

1. Plans, elevations, sections, hardware, accessories, insect screens, operational

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clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

D. Samples for Verification: Actual sample of finished products for each type of exposed finish:

1. Exposed Aluminum Finishes: Manufacturers' standard size.
2. Exposed Hardware: Full-size units.

E. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

F. Delegated Design Submittals: For reinforcing mullions, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports:

1. Product Test Reports: For each aluminum window, for tests performed by manufacturer and witnessed by a qualified testing agency.

B. Field Quality-Control Reports: For aluminum windows.

C. Qualification Statements: For manufacturer and Installer.

D. Delegated Design Engineer Qualifications: For reinforcing mullions.

E. Sample warranties.

1.6 CLOSEOUT SUBMITTALS

A. Warranty Documentation:

1. Manufacturers' special warranties.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports and calculations.

B. Installer Qualifications: Authorized representative who is trained and approved by aluminum window manufacturer.

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C. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of the type indicated.

D. Testing Agency Qualifications: An FGIA-accredited testing agency for testing indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver aluminum windows to Project site in original, unopened packages and store them in accordance with manufacturer's written instructions. Protect aluminum windows against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Handle aluminum windows in a manner that prevents damage before, during, and after installation.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install aluminum windows outside of limits recommended in writing by manufacturer.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Failure to meet performance requirements.
    b. Structural failures, including excessive deflection, water leakage, condensation, and air infiltration.
    c. Faulty operation of movable sash and hardware.
    d. Deterioration of materials and finishes beyond normal weathering.
    e. Failure of insulating glass.

2. Warranty Period:

    a. Window: Two years from date of Substantial Completion.
    b. Glazing Units: Five years from date of Substantial Completion.
    c. Hardware: Three years from date of Substantial Completion.
    d. Aluminum Finish: 20 years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain aluminum windows from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design reinforcing mullions.

B. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: FGIA certified with label attached to each window.

C. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: [R][LC][CW][AW][As indicated on Drawings]<Insert class>.
2. Minimum Performance Grade: 45.
3. Mulled Window Systems: Evaluate and rate combination assemblies as single systems as determined by AAMA 450 in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 requirements.

D. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor): As determined in accordance with NFRC 100:

a. Fixed Windows: Not more than 0.29 Btu/sq. ft. x h x deg F.
b. Operable Windows: Not more than 0.32 Btu/sq. ft. x h x deg F.

2. Solar Heat-Gain Coefficient (SHGC): As determined in accordance with NFRC 200:

a. Fixed Windows: Not more than 0.25.
b. Operable Windows: Not more than 0.33 as determined in accordance with NFRC 200.

3. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance in accordance with AAMA 1503, showing a CRF of 45.

E. Thermal Movements: Provide aluminum windows, including anchorage, which allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both

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solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F ambient; 180 deg F material surfaces.

F. Outdoor-Indoor Transmission Class (OITC): Rated for not less than 26 OITC when tested for laboratory sound transmission loss in accordance with ASTM E90 and determined by ASTM E1332.

G. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 3 for enhanced protection.

1. Large-Missile Test: For glazing located within 30 ft. of grade.
2. Small-Missile Test: For glazing located more than 30 ft. above grade.

2.3 ALUMINUM WINDOWS

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. EFCO Corporation
2. Kawneer Company, Inc.; Arconic Corporation
3. YKK AP America Inc.

B. Provide manufacturer's standard aluminum window assemblies consisting of frames, sashes, glass, hardware, fasteners, and all components and accessories as required for a complete installation.

C. Operating Types: Provide the following operating types in locations indicated on Drawings:

1. Casement: Outswing.
2. Projected, awning.
3. Fixed.

D. Frames and Sashes: Aluminum extrusions of alloy, temper, and strength complying with AAMA/WDMA/CSA 101/I.S.2/A440.

1. Thermally Broken Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.

E. Glass: Clear annealed glass, ASTM C1036, Type 1, Class 1, q3.

F. Windborne-Debris-Impact-Resistant Insulating-Glass Units: ASTM E2190, with two lites and complying with impact-resistance requirements in "Performance Requirements" Article.

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1. Exterior Lite: ASTM C1036, Type 1, Class 1, q3.

    a. Tint: Clear.
    b. Kind: Fully tempered.

2. Interior Lite: ASTM C1172, clear laminated glass with two plies of float glass.

    a. Float Glass: Fully tempered.
    b. Interlayer Thickness: As required by performance requirements indicated.

3. Filling: Fill space between glass lites with argon.
4. Low-E Coating: Sputtered on second or third surface.

G. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

H. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.

1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.

I. Window Hardware: Casement and projected.

1. Gear-Type Rotary Operators: Complying with AAMA 901 when tested in accordance with ASTM E405, Method A. Provide operators that function without requiring the removal of interior screens or using screen wickets.

    a. Type and Style: As selected by Architect from manufacturer's full range of types and styles.

2. Hinges: Non-friction type, not less than two per sash.
3. Lock: Lever handle and cam-action lock with keeper.
4. Limit Devices: Concealed friction adjustor, adjustable stay bar limit devices designed to restrict sash opening.

    a. Limit clear opening to 4 inches for ventilation; with custodial key release.

5. Pole Operators: Tubular-shaped anodized aluminum; with rubber-capped lower end and standard push-pull hook at top to match hardware design; of sufficient length to operate window without reaching more than 60 inches above floor; one pole operator and pole hanger per room that has operable windows more than 72 inches above floor.

J. Weather Stripping: Provide manufacturer's standard full-perimeter weather stripping for each operable sash unless otherwise indicated.

K. Fasteners: Noncorrosive and compatible with window members, trim, hardware,

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anchors, and other components.

1. Exposed Fasteners: Avoid exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

L. Mullions: Provide manufacturer's standard combination and reinforcing mullions and cover plates matching window units, complete with anchors for support to structure. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide reinforcing mullions and cover plates capable of withstanding design wind loads of window units.

2.4 ACCESSORIES

A. Dividers (False Muntins): Provide manufacturer's standard extruded-aluminum divider grilles in designs indicated for each sash lite.

1. Type: Permanently located between insulating-glass lites.
2. Pattern: As indicated on Drawings.
3. Profile: As selected by Architect from manufacturer's full range.

B. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated on Drawings.

C. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.

D. Panning Trim: Profiles in sizes and configurations indicated on Drawings.

E. Nail Fins: Manufacturer's standard mounting flanges with holes pre-punched for mechanical fasteners.

2.5 INSECT SCREENS

A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.

1. Type and Location: Full, inside for outswing sashes.

B. Aluminum Frames: Manufacturer's standard aluminum alloy complying with SMA 1201. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.

1. Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet.

C. Glass-Fiber Mesh Fabric: 20-by-20 or 20-by-30 mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration. Comply with ASTM D3656/D3656M.

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1. Mesh Color: Manufacturer's standard.

2.6 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Glaze aluminum windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.

F. Window Assemblies: Combination. Provide window units in configuration indicated on Drawings. Provide window frames, sashes, hardware, and other trim and components necessary for a complete, secure, and weathertight installation, including the following:

1. Combination and reinforcing mullions with interior and exterior trim.
2. Interior and exterior extension and trim.
3. Exterior head and sill casings and trim.

G. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA AMP 500 "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: 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.

2.8 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: As selected by Architect from full range of industry colors and color

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densities.

C. Organic Coatings:

1. Superior-Performance Fluoropolymer Finish: Three coats complying with AAMA 2605, containing not less than 50 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.

C. Examine wall flashings, vapor retarders, air and weather barriers, and other built-in components to ensure weathertight window installation.

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

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

C. Mullions: Install combination and reinforcing mullions for combination assemblies in accordance with manufacturer's written instructions.

D. Install windows and components to drain water passing joints and condensation to the exterior.

E. Separate aluminum from sources of corrosion or electrolytic action at points of contact with other materials.

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3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing Services: Testing and inspection of installed windows as follows:

1. Testing Methodology: Testing of windows for air infiltration and water resistance in accordance with AAMA 502.
2. Air-Infiltration Testing:

    a. Test Pressure: As required to determine compliance in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 for performance class indicated.
    b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.

3. Water-Resistance Testing:

    a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
    b. Allowable Water Infiltration: No water penetration.

4. Testing Extent: One window(s) of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows will be tested immediately after installation.
5. Test Reports: Prepared in accordance with AAMA 502.

C. Tests and Inspections:

1. Windows will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

3.5 CLEANING AND PROTECTION

A. Clean exposed surfaces immediately after installing windows using manufacturer's written instructions. Avoid damaging finishes. Remove excess sealants, glazing materials, dirt, and other substances.

B. Remove and replace glass that has been broken, chipped, cracked, abraded, or

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damaged during construction period.

C. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately in accordance with manufacturer's written instructions.

END OF SECTION 085113

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SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hinges.
2. Continuous, gear-type hinges.
3. Mortise locks.
4. Roller latches.
5. Push-pull latches.
6. Electric strikes.
7. Delayed-egress electromagnetic locks.
8. Exit locks and alarms.
9. Automatic flush bolts.
10. Exit devices and auxiliary items.
11. Lock cylinders.
12. Key control cabinet.
13. Key lock boxes.
14. Operating trim.
15. Surface closers.
16. Wall- and floor-mounted stops.
17. Overhead stops and holders.
18. Door gasketing.
19. Thresholds.
20. Metal protective trim units.

B. Related Requirements:

1. [Section 064100 "Architectural Wood Casework"][Section 064101 "Architectural Wood Casework (NAAWS Standard)"] for cabinet door hardware provided with cabinets.
2. Section 081113 "Hollow Metal Doors and Frames" [for astragals provided as part of labeled fire-rated assemblies][and][for door silencers provided as part of hollow-metal frames].
3. Section 081213 "Hollow Metal Frames" [for astragals provided as part of labeled fire-rated assemblies][and][for door silencers provided as part of hollow-metal frames].
4. Section 081216 "Aluminum Frames" for door silencers provided as part of aluminum frames.
5. Section 081416 "Flush Wood Doors" for [astragals][and][integral intumescent seals] provided as part of labeled fire-rated assemblies.
6. Section 081433 "Stile and Rail Wood Doors" for [astragals][and][integral intumescent seals] provided as part of labeled fire-rated assemblies.
7. Section 081713 "Integrated Metal Door Opening Assemblies" for door hardware provided as part of integrated metal door opening assemblies.

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8. Section 083113 "Access Doors and Frames" for access door hardware, [except][including] cylinders.
9. Section 083323 "Overhead Coiling Doors" for door hardware provided as part of overhead coiling door assemblies.
10. [Section 083473.13 "Metal Sound Control Door Assemblies"][and][Section 083473.16 "Wood Sound Control Door Assemblies"] for hinges and gasketing provided as part of sound-rated door assemblies.
11. Section 084113 "Aluminum-Framed Entrances and Storefronts" for entrance door hardware, [except][including] cylinders.
12. Section 087113 "Power Door Operators" for low-energy power operators and low-energy power-assist operators.
13. Section 102213 "Wire Mesh Partitions" for door hardware for doors in wire mesh partitions, [except][including] cylinders.
14. Section 102600 "Wall and Door Protection" for plastic door protection units that match wall protection units.
15. Section 281000 "Access Control" for coordination of access control system components.
16. Section 281400 "Access Control System Hardware" for access control system units, power, battery chargers, and computer equipment.
17. [Section 284600 "Fire Detection and Alarm"][and][Section 284614 "Single- and Multiple-Station Alarms"] for connections to building fire alarm system.

1.2 COORDINATION

A. Floor-Recessed Door Hardware: Coordinate layout and installation with floor construction.

1. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. 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. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field-verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]<Insert location>.

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1. Conference participants must include Installer's Architectural Hardware Consultant [and Owner's security consultant].

B. Keying Conference: Conduct conference at [Project site]<Insert location>.

1. Conference participants must include Installer's Architectural Hardware Consultant [and Owner's security consultant].
2. Incorporate conference decisions into keying schedule after reviewing door hardware keying system, including, but not limited to, the following:

a. Flow of traffic and degree of security required.
b. Preliminary key system schematic diagram.
c. Requirements for key control system.
d. Requirements for access control.
e. Address for delivery of keys.
f. <Insert requirements to suit Project>.

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 electrified door hardware.

1. Include diagrams for power, signal, and control wiring.
2. Include details of interface of electrified door hardware and building safety and security systems.

C. Samples: For each exposed product in each finish specified, in manufacturer's standard size.

1. Tag Samples with full product description to coordinate Samples with door hardware schedule.

D. Samples for Initial Selection: For each type of exposed finish.

E. Samples for Verification: For each type of exposed product, in each finish specified.

1. Sample Size: Full-size units or minimum 2-by-4-inch Samples for sheet and 4-inch long Samples for other products.

a. Full-size 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.

2. Tag Samples with full product description to coordinate Samples with door hardware schedule.

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F. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of product data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
2. Format: Use same scheduling sequence and format [and use same door numbers] as in door hardware schedule in the Contract Documents.
3. Content: Include the following information:

a. Identification number, location, hand, fire rating, size, and material of each door and frame.
b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
e. Fastenings and other installation information.
f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
g. Mounting locations for door hardware.
h. List of related door devices specified in other Sections for each door and frame.

G. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For [Installer][and][Architectural Hardware Consultant].

B. Product Certificates: For each type of electrified door hardware.

1. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.

C. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

D. Field quality-control reports.

E. Sample Warranty: For special warranty.

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1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals.

B. Schedules: Final [door hardware][and][keying] schedule.

1.7 MAINTENANCE MATERIAL SUBMITTALS

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

1. Door Hardware: <Insert detailed descriptions and specific numbers of units>.
2. Electrical Parts: <Insert detailed descriptions and specific numbers of units>.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as [a Door and Hardware Specification Consultant (DHSC)][an Architectural Hardware Consultant (AHC)][an Architectural Hardware Consultant (AHC) and an Electrified Hardware Consultant (EHC)][an Architectural Opening Consultant (AOC)].

1.9 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lockup for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

D. Deliver keys [and permanent cores] to Owner by registered mail or overnight package

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service.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including excessive deflection, cracking, or breakage.
b. Faulty operation of doors and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: [Three]<Insert number> years from date of Substantial Completion unless otherwise indicated below:

a. Electromagnetic and Delayed-Egress Locks: [Five]<Insert number> years from date of Substantial Completion.
b. Exit Devices: [Two]<Insert number> years from date of Substantial Completion.
c. Manual Closers: [10]<Insert number> years from date of Substantial Completion.
d. Concealed Floor Closers: [Five][10][25]<Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of door hardware from single manufacturer.

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.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.

B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested in accordance with UL 1784 and installed in compliance with NFPA

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105.

1. Air-Leakage Rate: Maximum air leakage of [0.3 cfm per sq. ft.]<Insert rate> at the tested pressure differential of [0.3 inch wg]<Insert value> of water.

C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with [the USDOJ's "2010 ADA Standards for Accessible Design"][the DOT's "ADA Standards for Transportation Facilities"][the ABA standards of the Federal agency having jurisdiction][ICC A117.1][HUD's "Fair Housing Accessibility Guidelines"][and]<Insert regulation>.

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.
2. Comply with the following maximum opening-force requirements:

    a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
    b. Sliding or Folding Doors: 5 lbf applied parallel to door at latch.
    c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

2.3 HINGES

A. Hinges: ANSI/BHMA A156.1. [Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.]

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. Allegion plc
    b. Hager Companies
    c. McKinney Products Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY

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2.4 CONTINUOUS HINGES

A. Continuous, Gear-Type Hinges: ANSI/BHMA A156.26; minimum 0.120-inch- thick, extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings. Minimum overall width of 4 inches; fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. Allegion plc
b. Hager Companies
c. Pemko Manufacturing Company Inc.; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY

2.5 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Mortise Locks: Minimum 3/4-inch latchbolt throw.
2. Deadbolts: Minimum 1.25-inch bolt throw.

C. Lock Backset: 2-3/4 inches unless otherwise indicated.

D. Lock Trim:

1. Description: [As indicated on Drawings]<Insert description or manufacturer's design designation>.
2. Levers: Cast.

a. <Insert model number and description>.

3. Escutcheons (Roses): Cast.
4. Dummy Trim: Match lever lock trim and escutcheons.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.

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4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.

F. Mortise Locks: ANSI/BHMA A156.13, Security Grade 2; stamped steel case with steel or brass parts; Series 1000.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. Allegion plc
b. Corbin Russwin, Inc.; an ASSA ABLOY Group company
c. Yale Security Inc; ASSA ABLOY

G. Roller Latches: ANSI/BHMA A156.16, Grade 1; rolling plunger that engages socket or catch, with adjustable roller projection.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. Allegion plc
b. Rockwood Manufacturing Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY

H. Push-Pull Latches: Mortise, ANSI/BHMA A156.13; with paddle handles that retract latchbolt; capable of being mounted vertically or horizontally.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. Allegion plc
b. Corbin Russwin, Inc.; an ASSA ABLOY Group company

2. Grade 2.

2.6 ELECTRIC STRIKES

A. Electric Strikes: ANSI/BHMA A156.31, Grade 2; with faceplate to suit lock and frame.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. Allegion plc
b. ASSA ABLOY Electronic Security Hardware; ASSA ABLOY

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c. Hager Companies

2.7 EXIT LOCKS AND EXIT ALARMS

A. Exit Locks and Alarms: ANSI/BHMA A156.29, Grade 1.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. Detex Corporation
b. Precision Hardware, Inc.; dormakaba Group
c. SARGENT Manufacturing Company; ASSA ABLOY

2.8 AUTOMATIC AND SELF-LATCHING FLUSH BOLTS

A. Automatic Flush Bolts: ANSI/BHMA A156.3, Type 25; minimum 3/4-inch throw; with dust-proof strikes; designed for mortising into door edge. [Include wear plates.]

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. Allegion plc

2.9 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: ANSI/BHMA A156.3.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. Allegion plc
b. C.R. Laurence Co., Inc.; CRH Americas, Inc.
c. Corbin Russwin, Inc.; an ASSA ABLOY Group company
d. Hager Companies

2.10 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. [Provide cylinder from same manufacturer of locking devices.]

1. Manufacturers: Subject to compliance with requirements, [provide products by

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the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. Allegion plc
b. Corbin Russwin, Inc.; an ASSA ABLOY Group company
c. Hager Companies

B. Standard Lock Cylinders: ANSI/BHMA A156.5, Grade 2 permanent cores; face finished to match lockset.

1. Core Type: Interchangeable.

C. High-Security Lock Cylinders: ANSI/BHMA A156.30, Grade 3 permanent cores that are removable; face finished to match lockset.

1. Type E, electrical.

D. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

E. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.11 KEYING

A. Keying System: Factory registered, complying with guidelines in ANSI/BHMA A156.28, appendix. Provide one extra key blank for each lock. [Incorporate decisions made in keying conference.]

1. No Master Key System: Only change keys operate cylinders.

a. Provide three cylinder change keys.

2. Master Key System: Change keys and a master key operate cylinders.

a. Provide three cylinder change keys and five master keys.

3. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.

a. Provide three cylinder change keys and five each of master and grand master keys.

4. Great-Grand Master Key System: Change keys, a master key, a grand master key, and a great-grand master key operate cylinders.

a. Provide three cylinder change keys and five each of master, grand master, and great-grand master keys.

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5. Existing System:

    a. Master key or grand master key locks to Owner's existing system.
    b. Re-key Owner's existing master key system into new keying system.

6. Keyed Alike: Key all cylinders to same change 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.

2.12 KEY CONTROL SYSTEM

A. Key Control Cabinet: ANSI/BHMA A156.28; metal cabinet with baked-enamel finish, containing key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of [150]<Insert number> percent of the number of locks.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. American Key Boxes and Cabinets
    b. HPC, a Hudson Lock Company

2. Multiple-Drawer Cabinet: Grade 2 cabinet with drawers equipped with key-holding panels, key envelope storage, and progressive-type ball-bearing suspension slides. Include single cylinder lock to lock all drawers.
3. Wall-Mounted Cabinet: Grade 2 cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.
4. Portable Cabinet: Grade 2 tray for mounting in file cabinet, equipped with key-holding panels, envelopes, and cross-index system.

B. Key Lock Boxes: Designed for storage of 10 keys.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. HPC, a Hudson Lock Company
    b. Knox Company

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2.13 OPERATING TRIM

A. Operating Trim: ANSI/BHMA A156.6; [aluminum][brass][bronze][stainless steel] unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. Allegion plc
b. Hager Companies
c. Rockwood Manufacturing Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY

2.14 ACCESSORIES FOR PAIRS OF DOORS

A. Coordinators: ANSI/BHMA A156.3; consisting of active-leaf, hold-open lever, and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release [; and with internal override].

B. Carry-Open Bars: ANSI/BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.

C. Astragals: ANSI/BHMA A156.22.

2.15 SURFACE CLOSERS

A. Surface Closers: ANSI/BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. Allegion plc
b. Corbin Russwin, Inc.; an ASSA ABLOY Group company
c. Hager Companies

2.16 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: ANSI/BHMA A156.16.

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1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. Allegion plc
    b. Hager Companies
    c. Rockwood Manufacturing Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY

2.17 OVERHEAD STOPS AND HOLDERS

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

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. Allegion plc
    b. Hager Companies
    c. SARGENT Manufacturing Company; ASSA ABLOY

2.18 DOOR GASKETING

A. Door Gasketing: ANSI/BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. Hager Companies
    b. National Guard Products, Inc
    c. Pemko Manufacturing Company Inc.; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY

B. Maximum Air Leakage: When tested in accordance with ASTM E283/E283M with tested pressure differential of 0.3 inch wg, as follows:

1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. of door opening.
2. Gasketing on Single Doors: 0.3 cfm/sq. ft. of door opening.
3. Gasketing on Double Doors: 0.50 cfm per ft. of door opening.

2.19 THRESHOLDS

A. Thresholds: ANSI/BHMA A156.21; fabricated to full width of opening indicated.

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1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. Hager Companies
    b. National Guard Products, Inc

2.20 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: ANSI/BHMA A156.6; fabricated from 0.050-inch- thick [aluminum][brass][bronze][stainless steel]; with manufacturer's standard machine or self-tapping screw fasteners.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. Allegion plc
    b. Hager Companies
    c. Rockwood Manufacturing Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY

2.21 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-rating 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 indicated, 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 ANSI/BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended; however, 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.

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2. Fire-Rated Applications:

   a. Wood or Machine Screws: For the following:

      1) Hinges mortised to doors or frames [; use threaded-to-the-head wood screws for wood doors and frames].
      2) Strike plates to frames.
      3) Closers to doors and frames.

   b. Steel Through Bolts: For the following unless door blocking is provided:

      1) Surface hinges to doors.
      2) Closers to doors and frames.
      3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.22 FINISHES

A. Provide finishes complying with ANSI/BHMA A156.18 as indicated in door hardware schedule.

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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.

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.

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3.2 PREPARATION

A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames in accordance with ANSI/SDI A250.6.

B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.3 INSTALLATION OF DOOR HARDWARE

A. Mounting Heights: Mount door hardware units at heights [indicated on Drawings][to comply with the following] unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

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 in accordance with industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches of door height greater than 90 inches.

E. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as [indicated in keying schedule][directed by Owner].
2. Furnish permanent cores to Owner for installation.

F. Key Control System:

1. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

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2. Key Lock Boxes: Install where indicated or approved by Architect to provide controlled access for fire and medical emergency personnel.

G. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, [above accessible ceilings][in equipment room]. Verify location with Architect.

1. Configuration: Provide [one power supply for each door opening][least number of power supplies required to adequately serve doors] with electrified door hardware.

H. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

I. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

J. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

1. Do not notch perimeter gasketing to install other surface-applied hardware.

K. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

L. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant: [Owner will engage][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. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.

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3. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

B. Occupancy Adjustment: Approximately [three][six]<Insert number> months after date of Substantial Completion, Installer's Architectural Hardware Consultant is to examine and readjust each item of door hardware, including adjusting operating forces, 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 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Maintenance Service: Beginning at Substantial Completion, maintenance service is to include [six][nine][12]<Insert number> 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 and door hardware operation. Parts and supplies are to be manufacturer's authorized replacement parts and supplies.

3.8 DEMONSTRATION

A. [Engage Installer to train][Train] Owner's maintenance personnel to adjust, operate, and maintain door hardware.

END OF SECTION 087100

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SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass products.
2. Laminated glass.
3. Insulating glass.
4. Glazing tapes.
5. Miscellaneous glazing materials.

B. Related Requirements:

1. Section 057313 "Glazed Decorative Metal Railings" for glazing in railings.
2. Section 084126 "All-Glass Entrances and Storefronts."
3. Section 084233 "Revolving Door Entrances" for glass in revolving door entrances.
4. Section 084423 "Structural-Sealant-Glazed Curtain Walls" for glazing sealants used in structural-sealant-glazed curtain walls.
5. Section 088113 "Decorative Glass Glazing."
6. Section 088300 "Mirrors."
7. Section 088813 "Fire-Rated Glazing."
8. Section 088853 "Security Glazing."

1.2 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

C. IBC: International Building Code.

D. Interspace: Space between lites of an insulating-glass unit.

1.3 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

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1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]<Insert location>.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of [glass product other than clear monolithic vision glass][the following products]; 12 inches square.

1. Tinted glass.
2. Coated glass.
3. Laminated glass.
4. Insulating glass.
5. Spandrel glass.

C. Glazing Accessory Samples: For [sealants][and][colored spacers], in 12-inch lengths. [Install sealant Samples between two strips of material representative in color of adjoining framing system.]

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

E. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For [Installer][manufacturers of fabricated glass units][glass testing agency][and][sealant testing agency].

B. Product Certificates: For glass.

C. Product Test Reports: For [fabricated glass][and][glazing sealants], for tests performed by a qualified testing agency.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Preconstruction adhesion and compatibility test report.

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E. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved [and certified] by primary glass manufacturer.

B. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors [and who employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program].

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

E. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Install glazing in mockups specified in [Section 084113 "Aluminum-Framed Entrances and Storefronts"][Section 085113 "Aluminum Windows"][Section 084413 "Glazed Aluminum Curtain Walls"]<Insert Section number and title> to match glazing systems required for Project, including glazing methods.
2. 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 Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C1087 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]<Insert number> Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule enough 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 use of specially formulated primers.

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1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10 FIELD 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 glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.11 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: [10]<Insert number> years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to 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. Warranty Period: [Five][10]<Insert number> years from date of Substantial Completion.

C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.

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1. Warranty Period: [10]<Insert number> years from date of Substantial Completion.

D. Manufacturer's Special Warranty for Heat-Soaked Tempered Glass: Manufacturer agrees to replace heat-soaked tempered glass units that spontaneously break due to nickel sulfide (NiS) inclusions at a rate exceeding 0.3 percent (3/1000) within specified warranty period. Coverage for any other cause is excluded.

1. Warranty Period: [Five][10]<Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations for Glass: Obtain [tinted][and][coated] glass from single source from single manufacturer.

B. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:

1. Design Wind Pressures: As indicated on Drawings.

a. Wind Design Data: As indicated on Drawings.
b. Basic Wind Speed: 140 mph.
c. Importance Factor: 1.0.
d. Exposure Category: D.

2. Design Snow Loads: As indicated on Drawings.
3. Probability of Breakage for Sloped Glazing: For glass sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
4. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-

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side length or 1 inch, whichever is less.

5. Thermal Loads: Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.

D. Windborne-Debris-Impact Resistance: Exterior glazing shall pass ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone [1][2][3][4] for [basic][enhanced] protection.

1. Large-Missile Test: For glazing located within [30 feet]<Insert dimension> of grade.
2. Small-Missile Test: For glazing located between 30 feet and [60 feet]<Insert dimension> above grade.

E. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

F. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites of thickness indicated.
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.
4. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F.
5. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
6. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

G. Acoustic Performance:

1. Exterior Glazing: 35 OITC.
2. Interior Glazing: 41 STC.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. NGA Publications: ["Laminated Glazing Reference Manual" and] "Glazing Manual."
2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and

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AAMA TIR A7, "Sloped Glazing Guidelines."

3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of [the SGCC][the SGCC or another certification agency acceptable to authorities having jurisdiction][or][manufacturer]. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Thickness: Where glass thickness is indicated, it is a minimum. [Provide glass that complies with performance requirements and is not less than thickness indicated.]

1. Minimum Glass Thickness for Exterior Lites: [6 mm]<Insert thickness designation>.
2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass [as needed to comply with "Performance Requirements" Article]. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass [as needed to comply with "Performance Requirements" Article]. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. AGC Glass Company North America, Inc.
b. Cardinal Glass Industries, Inc.
c. Pilkington North America; NSG Group

B. Tinted Annealed Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. AGC Glass Company North America, Inc.
b. Pilkington North America; NSG Group

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C. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

D. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

E. Reflective- and Low-E-Coated Vision Glass: ASTM C1376.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. Cardinal Glass Industries, Inc.
b. Pilkington North America; NSG Group

F. Ceramic-Coated Vision Glass: ASTM C1048, Condition C, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3; and complying with Specification No. 95-1-31 in NGA's "Engineering Standards Manual."

G. Ceramic-Coated Spandrel Glass: ASTM C1048, Type I, Condition B, Quality-Q3.

H. Reflective- and Low-E-Coated Spandrel Glass: ASTM C1376, Kind CS.

2.5 LAMINATED GLASS

A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. Dreamwalls
b. Kuraray America, Inc.
c. Pilkington North America; NSG Group

2. Construction: Laminate glass with [polyvinyl butyral interlayer][ionoplast interlayer][or][cast-in-place and cured-transparent-resin interlayer] to comply with interlayer manufacturer's written instructions.

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3. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
4. Interlayer Color: Clear unless otherwise indicated.

B. Windborne-Debris-Impact-Resistant Laminated Glass: Comply with requirements specified above for laminated glass except laminate glass with [one of] the following to comply with interlayer manufacturer's written instructions:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

   a. Kuraray America, Inc.
   b. Saflex; Eastman

2. Construction: Laminate glass with polyvinyl butyral interlayer reinforced with polyethylene terephthalate film to comply with interlayer manufacturer's written instructions.
3. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
4. Interlayer Color: Clear unless otherwise indicated.

2.6 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
2. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.7 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.

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2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by 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:

1. EPDM with Shore A durometer hardness of 85, plus or minus 5.
2. Type recommended in writing by sealant or glass manufacturer.

D. Spacers:

1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
2. Type recommended in writing by sealant or glass manufacturer.

E. Edge Blocks:

1. EPDM with Shore A durometer hardness per manufacturer's written instructions.
2. Type recommended in writing by sealant or glass manufacturer.

F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing

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sealant performance.

2.10 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit 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.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

a. Temperature Change: [120 deg F, ambient; 180 deg F, material surfaces]<Insert temperature change>.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, 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 systems.
3. Minimum required face and 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.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

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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. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.

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.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

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 in writing by gasket manufacturer.

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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, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right 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. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

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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. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces 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

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SECTION 088813 - FIRE-RATED GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glazing sealants.
2. Glazing tapes.
3. Miscellaneous glazing materials.

1.2 DEFINITIONS

A. Fire-Protection-Rated Glazing: Glazing that prevents spread of fire and smoke and complies with requirements for rated openings; incapable of blocking radiant heat

B. Fire-Resistance-Rated Glazing: Glazing that prevents spread of fire and smoke and radiant heat and complies with requirements for rated walls and rated openings; capable of blocking radiant heat

C. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

D. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

1.3 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.4 ACTION SUBMITTALS

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

B. Glass Samples: For each type of glass product; 12 inches square.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

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1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of glass and glazing product.

B. Qualification Statements: For [Installer][and][glass testing agency].

C. Sample Warranties: For specified special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the NGA's Certified Glass Installer Program.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install fire-resistant glazing until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature conditions at occupancy levels during remainder of construction period.

1.9 WARRANTY

A. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to 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. Warranty Period: [Five][10]<Insert number> years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Tempered Glazing Units with Clear Intumescent Interlayer: Manufacturer agrees to replace units that deteriorate within specified warranty period. Deterioration of tempered glazing units with clear intumescent interlayer is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning glass contrary to manufacturer's written instructions. Evidence of failure is air bubbles within units, or obstruction of vision by contamination or deterioration of intumescent interlayer.

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1. Warranty Period: [Five][10]<Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Glass: For each glass type, obtain from single source from single manufacturer.

B. Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems will withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.

2.3 GLASS MATERIALS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organization below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. NGA Publications: ["Laminated Glazing Reference Manual" and] "Glazing Manual."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of [the SGCC][the SGCC or another certification agency acceptable to authorities having jurisdiction][or][manufacturer]. Label will indicate manufacturer's name, type of glass, glass thickness, and safety glazing standard with which glass complies.

C. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with glazing products and each other and are approved by testing agencies that listed and labeled fire-resistant glazing products with which products are used for applications and fire-protection ratings indicated.

2.4 GLASS MATERIALS

A. Float Glass : ASTM C1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

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B. Laminated Glass : ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer unless fire-protection or fire-resistance rating is based on another product.
2. Interlayer Thickness: Provide thickness as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

2.5 FIRE-PROTECTION-RATED GLAZING

A. General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on positive-pressure testing in accordance with NFPA 257 or UL 9, including hose-stream test, and will comply with NFPA 80.

1. Fire-protection-rated glazing required to have a fire-protection rating of 20 minutes shall be exempt from hose-stream test.

B. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label will indicate manufacturer's name; test standard; whether glazing is permitted to be used in doors or openings; if permitted in openings, whether glazing has passed hose-stream test; whether glazing meets 450 deg F temperature-rise limitation; and fire-resistance rating in minutes.

2.6 FIRE-RESISTANCE-RATED GLAZING

A. General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-resistance ratings indicated, based on testing in accordance with ASTM E119 or UL 263.

B. Fire-Resistance-Rated Glazing Labeling: Permanently mark fire-resistance-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label will indicate manufacturer's name, test standard, that glazing is approved for use in walls, and fire-resistance rating in minutes.

C. Fire-Resistance-Rated Framing and Doors: Fire-resistance-rated glazing with 60-, 90-, and 120-minute ratings requires framing and doors from glass supplier, tested as an assembly complying with ASTM E119 or UL 263.

2.7 GLAZING SEALANTS

A. Glazing Sealants for Fire-Rated Glazing Products: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.

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1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. GE Construction Sealants; Momentive Performance Materials Inc.
    b. The Dow Chemical Company.
    c. Tremco Incorporated.
    d. <Insert manufacturer's name>.

2. Basis-of-Design Product: Subject to compliance with requirements, provide <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
3. Colors of Exposed Glazing Sealants: [As indicated by manufacturer's designations][Match Architect's samples][As selected by Architect from manufacturer's full range of industry colors].

2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

    1. AAMA 804.3 tape, where indicated.
    2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
    3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

    1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
    2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

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C. Perimeter Insulation for Fire-Resistance-Rated Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.10 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with manufacturing and installation tolerances, including those for size, squareness, and offsets at corners, and for compliance with minimum required face and edge clearances.

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.

B. Examine glazing units to locate fire side and protected side. Label or mark units as needed so that fire side and protected side are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 INSTALLATION OF GLAZING, GENERAL

A. Use methods approved by testing agencies that listed and labeled fire-resistant glazing products.

B. 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.

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

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by preconstruction 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.

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 in accordance with requirements in referenced glazing publications.

I. Set glass lites with proper orientation so that coatings face fire side or protected side as specified.

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 in writing by gasket manufacturer.

3.4 INSTALLATION OF GLAZING TAPES

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.

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E. Do not remove release paper from tape until right 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 INSTALLATION OF GLAZING GASKET (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop, so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

D. Install gaskets so they protrude past face of glazing stops.

3.6 INSTALLATION OF GLAZING SEALANTS

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances. 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

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Wash glass on both exposed surfaces 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.

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3.8 PROTECTION

A. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

B. Remove and replace glass that is damaged during construction period.

END OF SECTION 088813

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SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed [extruded-aluminum][and][formed-metal] louvers.
2. Fixed formed-metal acoustical louvers.
3. Blank-off panels for louvers

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames" for louvers in hollow-metal doors.
2. Section 081416 "Flush Wood Doors" for louvers in flush wood doors.
3. Section 099113 "Exterior Painting" for field painting exterior louvers.
4. Section 099123 "Interior Painting" for field painting interior louvers.

1.2 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 axis of the blades are horizontal).

C. Vertical Louver: Louver with vertical blades (i.e., the axis 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. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven-rain performance, as determined by testing in accordance with AMCA 500-L.

F. Windborne-Debris-Impact-Resistant Louver: Louver that provides specified windborne-debris-impact resistance, as determined by testing in accordance with AMCA 540.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing

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specified models with appropriate AMCA Certified Ratings Seals.

B. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party Certified Life Cycle Assessment: For each product.
3. Third-Party Certifications: For each product.
4. Third-Party Certified Life Cycle Assessment: For each product.

C. 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, flashings, sealants, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

D. Samples: 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.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed in accordance with 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.

B. Windborne-debris-impact-resistance test reports.

C. Sample Warranties: For manufacturer's special warranties.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

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1.7 WARRANTY

A. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: [Five][10][20]<Insert number> years from date of Substantial Completion.

B. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, peeling, or chipping.

2. Warranty Period: [Five][10]<Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain fixed [and operable] louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural [and seismic] performance requirements and design criteria indicated.

B. Structural Performance: Louvers withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent

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deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures are considered to act normal to the face of the building.

1. Wind Loads:

    a. Determine loads based on pressures as indicated on Drawings.
    b. Determine loads based on a uniform pressure of [20 lbf/sq. ft.][30 lbf/sq. ft.]<Insert value>, acting inward or outward.
    c. Determine loads based on pressures indicated below:

        1) Corner Zone: Within <Insert distance> of building corners, uniform pressure of <Insert design wind pressure>, acting inward, and <Insert design wind pressure>, acting outward.
        2) Other Than Corner Zone: Uniform pressure of <Insert design wind pressure>, acting inward, and <Insert design wind pressure>, acting outward.

C. Windborne-Debris-Impact Resistance: Louvers located within 30 feet of grade pass [basic][enhanced] protection, when tested in accordance with AMCA 540.

D. Seismic Performance:

1. As indicated on Drawings.
2. Louvers, including attachments to other construction, withstand the effects of earthquake motions determined in accordance with [ASCE/SEI 7]<Insert requirement>.

    a. Design earthquake spectral response acceleration, short period (Sds) for Project is <Insert value>.
    b. Component Importance Factor: [1.5][1.0].

E. 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 in accordance with AMCA 500-L.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): [120 deg F, ambient; 180 deg F, material surfaces]<Insert temperature range>.

G. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Wind-Driven-Rain-Resistant Louver, Extruded Aluminum:

1. Manufacturers: Subject to compliance with requirements, [provide products by

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the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. Ruskin; Air Distribution Technologies, Inc.
b. Greenheck Fan Corporation

2. Louver Depth: 5 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
4. Louver Performance Ratings:

a. Free Area: Not less than 7.0 sq. ft. for 48-inch- wide by 48-inch- high louver.
b. Air Performance: Not more than [0.10-inch wg]<Insert value> static pressure drop at 700-fpm free-area [exhaust][intake] velocity.
c. Wind-Driven Rain Performance: Not less than 95 percent effectiveness when subjected to a rainfall rate of 8 inches per hour and a wind speed of 50 mph at a core-area intake velocity of 400 fpm.

5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

B. Horizontal, Drainable-Blade, Windborne-Debris-Impact-Resistant Louver, Extruded Aluminum:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. Greenheck Fan Corporation

2. Louver Depth: 6 inches.
3. Frame and Blade Nominal Thickness: Not less than [0.080 inch]<Insert dimension>.
4. Mullion Type: Exposed.
5. Louver Performance Ratings:

a. Free Area: Not less than 8.5 sq. ft. for 48-inch- wide by 48-inch- high louver.
b. Point of Beginning Water Penetration: Not less than 1100 fpm.
c. Air Performance:

1) Not more than [0.16-inch wg]<Insert value> static pressure drop at [989-fpm]<Insert value> free-area [exhaust][intake] velocity.
2) Not more than [0.15-inch wg]<Insert value> static pressure drop at [1077-fpm]<Insert value> free-area [exhaust][intake] velocity.

6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
7. AMCA Rating: AMCA 540.

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2.4 LOUVER SCREENS

A. General: Provide screen at [each exterior louver][louvers indicated].

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Bird screening, except where insect screening is indicated.

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 type 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. Bird Screening, Stainless Steel: 1/2-inch- square mesh, 0.047-inch wire.
3. Bird Screening, Flattened, Expanded Aluminum: 3/4 by 0.050 inch thick.
4. Insect Screening, Aluminum: 18-by-16 mesh, 0.012-inch wire.
5. Insect Screening, Stainless Steel: 18-by-18 mesh, 0.009-inch wire.

E. Louver Screening for Galvanized-Steel Louvers:

1. Bird Screening, Galvanized Steel: 1/2-inch- square mesh, 0.041-inch wire.
2. Bird Screening, Stainless Steel: 1/2-inch- square mesh, 0.047-inch wire.
3. Insect Screening, Galvanized Steel: 18-by-14 mesh, 0.011-inch wire.
4. Insect Screening, Stainless Steel: 18-by-18 mesh, 0.009-inch wire.

F. Louver Screening for Stainless Steel Louvers:

1. Bird Screening, Stainless Steel: 1/2-inch- square mesh, 0.047-inch wire.
2. Insect Screening, Stainless Steel: 18-by-18 mesh, 0.009-inch wire.

2.5 BLANK-OFF PANELS

A. Uninsulated Blank-Off Panels: Metal sheet attached to back of louver.

1. Aluminum sheet for aluminum louvers, not less than 0.050-inch nominal thickness.
2. Galvanized-steel sheet for galvanized-steel louvers, not less than [0.040-inch][0.052-inch] nominal thickness.
3. Stainless steel sheet for stainless steel louvers, not less than [0.038-inch][0.050-inch] nominal thickness, with grain running in same direction as grain of louver blades.
4. Panel Finish: [Same finish applied to louvers][Same finish type applied to louvers, but black color].

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5. Attach blank-off panels with [clips][sheet metal screws]<Insert method>.

B. Insulated Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.

1. Thickness: [1 inch][2 inches].
2. Metal Facing Sheets, Aluminum: Not less than 0.032-inch nominal thickness.
3. Metal Facing Sheets, Galvanized Steel: Not less than 0.028-inch nominal thickness.
4. Metal Facing Sheets, Stainless Steel: Not less than 0.031-inch nominal thickness.
5. Insulating Core: [Rigid, glass-fiber-board insulation][or][extruded-polystyrene foam]<Insert insulation material>.
6. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard [extruded-aluminum-channel frames, not less than 0.080-inch nominal thickness][channel frames], with corners mitered and with same finish as panels.
7. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
8. Panel Finish: [Same finish applied to louvers][Same type of finish applied to louvers, but black color].
9. Attach blank-off panels with [clips][sheet metal screws]<Insert method>.

2.6 MATERIALS

A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Galvanized-Steel Sheet: ASTM A653/A653M, [G60][G90] zinc coating, mill phosphatized.

D. Stainless Steel Sheet: ASTM A240/A240M, Type 304, [No. 2B finish][No. 2D finish][No. 4 finish, with grain running parallel to length of blades and frame members][No. 4 finish, with grain running perpendicular to length of blades and frame members][No. 4 finish, with grain running perpendicular to length of blades and parallel to length of frame members][No. 6 finish].

E. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use [Phillips flat-head][hex-head or Phillips pan-head][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

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anchors, fabricated from stainless steel components, with allowable load or strength design capacities calculated in accordance with ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing in accordance with ASTM E488/E488M conducted by a qualified testing agency.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

H. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25]<Insert value> percent.

I. Recycled Content of Aluminum Components: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25][50]<Insert value> percent.

2.7 FABRICATION

A. Factory assemble louvers 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][where indicated].
2. Horizontal Mullions: Provide horizontal mullions at joints [unless continuous vertical assemblies are indicated][where 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][Exterior flange][Interior flange] 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 is 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

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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][blades with concealed close-fitting splices] and with [fully recessed][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 [concealed from view][, threaded fasteners, or both, as standard with louver manufacturer] unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.8 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. Clear Anodic Finish: AAMA 611, [AA-M12C22A41, Class I, 0.018 mm][AA-M12C22A31, Class II, 0.010 mm] or thicker.

C. Color Anodic Finish: AAMA 611, [AA-M12C22A42/A44, Class I, 0.018 mm][AA-M12C22A32/A34, Class II, 0.010 mm] or thicker.

1. Color: As selected by Architect from full range of industry colors and color densities.

D. Conversion-Coated Finish: AA-C12C42, nonetched, cleaned with inhibited chemicals, and chemical conversion coated with acid chromate-fluoride-phosphate.

E. Factory-Primed Finish: AA-C12C42R1x with air-dried primer of not less than 2-mil dry film thickness.

F. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

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

G. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with [AAMA 2604][AAMA 2605] and containing not less than [50][70] percent PVDF resin by weight in color coat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe

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

H. Superior-Performance Organic Finish, Three-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
2. Color and Gloss: As selected by Architect from manufacturer's full range.

I. Superior-Performance Organic Finish, Four-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
2. Color and Gloss: As selected by Architect from manufacturer's full range.

J. Superior-Performance Organic Finish, Single-Coat FEVE: Fluoropolymer finish complying with AAMA 2605.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color and Gloss: As selected by Architect from manufacturer's full range.

K. Superior-Performance Organic Finish, Two-Coat FEVE: Fluoropolymer finish complying with AAMA 2605.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
2. 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 of the Work.

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

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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 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. Protect unpainted galvanized- and nonferrous-metal surfaces that are 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.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers 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 089119

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SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonstructural steel framing.
2. Grid suspension systems.

B. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior loadbearing, structural framing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]<Insert location>.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of nonstructural steel framing and fastening and anchorage details.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, and attachments to adjoining work.
3. <Insert requirements>.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For code-compliance certification of studs and track.

B. Evaluation Reports: From [an agency acceptable to authorities having jurisdiction][ICC-ES]<Insert evaluation agency> showing compliance with Project requirements, for the following:

1. Studs and track.
2. High-strength steel studs and track.
3. Equivalent corrosion-resistant coating on steel framing.
4. Firestop track.
5. Post-installed anchors.

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6. Power-actuated fasteners.
7. <Insert requirements>.

1.5 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Track: Provide documentation that framing members are certified in accordance with product-certification program of [the Steel Framing Industry Association][the Steel Stud Manufacturers Association][or][the Supreme Steel Framing System Association].

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Protect materials from corrosion, deformation, and other damage during delivery, storage, and handling in accordance with AISI S202.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Where indicated on Drawings, provide assemblies incorporating nonstructural steel framing identical to those of assemblies tested for fire resistance in accordance with ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: Where indicated on Drawings, provide assemblies incorporating nonstructural framing identical to those of assemblies tested in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

C. Horizontal Deflection: For [composite][non-composite] wall assemblies, limited to [1/240][1/360]<Insert requirements> of the wall height based on the following horizontal loading:

1. Horizontal Loading: [As indicated on Drawings][5 lbf/sq. ft.][10 lbf/sq. ft.]<Insert value>.

2.2 NONSTRUCTURAL STEEL FRAMING

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

B. Framing Members, General: Comply with requirements in AISI S220 for conditions indicated on Drawings.

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1. Protective Coating: ASTM A653/A653M, G40 or coating with demonstrated equivalent corrosion resistance. Galvannealed products are unacceptable.

    a. Equivalent Corrosion-Resistant Coating: Evaluation report acceptable to authorities having jurisdiction demonstrates corrosion resistance equivalent to specified protective coating.

C. Slip-Type Head Joints: Where indicated on Drawings, provide [one of] the following:

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Adjustable Wall-Furring Brackets: ASTM A653/A653M G40 hot-dip galvanized steel sheet in minimum 0.0329-inch- base-steel thickness with serrated edges for attaching furring channels to exterior masonry or concrete walls.

C. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.

1. Adjustable Wall-Furring Brackets for Tie Wire: Use minimum double strand of 0.0625-inch- diameter wire, or triple strand of 0.0475-inch- diameter wire to attach furring channels.
2. Suspended-Ceiling Systems:

    a. Splicing Carrying Channels and Furring Members: Use double loops of minimum 0.0625-inch- diameter wire.
    b. Saddle Tying Main Runners and Cross Furring: Use minimum 0.0625-inch-diameter wire, or double strand of 0.0475-inch- diameter wire.

D. Post-Installed Anchors: Fastener systems with an evaluation report, acceptable to authorities having jurisdiction, based on ICC-ES [AC01][AC193][AC58][or][AC308] as appropriate for the substrate.

1. Securing Hangers:

    a. Type: Torque-controlled, expansion anchor.
    b. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated on Drawings.
    c. Stainless Steel Material for Exterior or Interior Locations: Alloy Group 2 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

E. Power-Actuated Anchors: Fastener systems with an evaluation report, acceptable to authorities having jurisdiction, based on ICC-ES AC70.

F. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, [0.162 inch]<Insert dimension> in diameter.

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G. Flat Hangers: ASTM A653/A653M G40 hot-dip galvanized steel sheet, 1 by 3/16 inch by length indicated on Drawings.

H. Isolation Strip at Exterior Walls: Provide [one of] the following:

1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, substrates, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices required to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling track to surfaces indicated on Drawings to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of nonstructural steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated on Drawings. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION OF NONSTRUCTURAL METAL FRAMING, GENERAL

A. Installation Standard: ASTM C754.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.

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2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C1063 that apply to framing installation.
3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C844 that apply to framing installation.
4. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with framing members. Frame both sides of joints independently.

3.4 INSTALLATION OF NONSTRUCTURAL STEEL FRAMING

A. Install framing system components at spacings indicated on Drawings, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: [As required by horizontal deflection performance requirements][16 inches o.c.][24 inches o.c.] unless otherwise indicated on Drawings.
2. Multilayer Application: [As required by horizontal deflection performance requirements][16 inches o.c.][24 inches o.c.] unless otherwise indicated on Drawings.
3. Tile Backing Panels: [As required by horizontal deflection performance requirements][16 inches o.c.] unless otherwise indicated on Drawings.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install track at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated on Drawings to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated on Drawings.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum

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1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.

c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure unless otherwise indicated on Drawings.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated on Drawings. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated on Drawings and support closures to make partitions continuous from floor to underside of solid structure.
5. STC-Rated Partitions: Install framing to comply with STC-rated assembly indicated on Drawings.
6. Curved Partitions:

a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of at least two studs at ends of arcs, place studs 6 inches o.c.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Wall-Furring Bracket Systems: Install brackets with serrated edges facing upward spaced at minimum 48 inches o.c. vertically with 6 inches maximum from floor and ceiling, and minimum 36 inches o.c. horizontally with 4 inches maximum from abutting construction, unless otherwise indicated on Drawings.

G. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced [24 inches]<Insert dimension> o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

H. Suspended Assemblies: Isolate suspension assemblies from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

1. Hangers: Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or

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suspension system spaced [as indicated on Drawings]<Insert requirements>.

a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
b. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

1) Size supplemental suspension members and hangers to support ceiling loads within [performance limits established by referenced installation standards]<Insert deflection limit>.

c. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
d. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
e. Do not attach hangers to steel roof deck.
f. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
g. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
h. Do not connect or suspend framing from ducts, pipes, or conduit.

2. Carrying Channels (Main Runners): U-channels spaced [as indicated on Drawings]<Insert requirements>.
3. Furring Channels (Furring Members): [As indicated on Drawings][U-channels][Steel studs and track][High-strength steel studs and track][Rigid hat-shaped furring channels][Resilient furring channels]<Insert requirements>.

a. Spacing: [As indicated on Drawings]<Insert requirements>.
b. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

4. Seismic Bracing: Sway-brace suspension systems [with hangers used for support]<Insert requirements>.

I. Installation Tolerances for Nonstructural Steel Framing:

1. Framing Members: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.
2. Suspended Assemblies: Install suspension systems that are level to within [1/8 inch in 12 ft.]<Insert dimensions> measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

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3.5 INSTALLATION OF GRID SUSPENSION SYSTEMS

A. Grid Suspension Systems: Install in accordance with manufacturer's written instructions. Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

B. Installation Tolerances for Grid Suspension Systems: Install suspension systems that are level to within [1/8 inch in 12 ft.]<Insert dimensions> measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

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SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.
3. Trim accessories.

B. Related Requirements:

1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
2. Section 079219 "Acoustical Joint Sealants" for acoustical joint sealants installed in gypsum board assemblies.
3. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for steel shaft wall framing, gypsum shaft liners, and other components of shaft wall assemblies.
4. Section 092216 "Non-Structural Metal Framing" for nonstructural steel framing and suspension systems that support gypsum board panels.
5. Section 092613 "Gypsum Veneer Plastering" for gypsum base for veneer plaster and for other components of gypsum-veneer-plaster finishes.
6. Section 093013 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Locations and installation of control and expansion joints, including plans, elevations, sections, and attachment details.

C. Samples for Initial Selection:

1. Trim Accessories: For [aluminum][and][base-of-wall PVC moisture-barrier]<Insert requirements> trim.
2. Texture Finish: For each type required.

D. Samples for Verification: Actual sample of finished products for the following:

1. Trim Accessories: Actual sample of finished products for each profile of [aluminum][and][base-of-wall PVC moisture-barrier]<Insert requirements> trim required.

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a. Size: Full size profile, [12 inches]<Insert dimension> long,

2. Textured Finishes: [Manufacturer's standard size]<Insert requirements> for each textured finish required and on same backing indicated for Work.

1.3 MOCKUPS

A. Build mockups of at least [100 sq. ft.]<Insert dimension> in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockups for the following:

a. Each level of gypsum board finish required for use in exposed locations.
b. Each texture finish required.

2. Apply or install final decoration required, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

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PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of gypsum panel and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings in accordance with ASTM E119; tested by a qualified testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings in accordance with ASTM E90 and classified in accordance with ASTM E413; tested by a qualified testing agency.

2.3 GYPSUM BOARD, GENERAL

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent.

B. Size: Provide panel products in maximum lengths and widths available that will minimize joints in each area and that correspond with support system specified or indicated on Drawings.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized-steel sheet or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
2. Shapes:

    a. Cornerbead.
    b. Bullnose bead.
    c. LC-Bead: J-shaped; exposed long flange receives joint compound.
    d. L-Bead: L-shaped; exposed long flange receives joint compound.
    e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    f. Expansion (control) joint.
    g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Exterior Trim: ASTM C1047.

1. Material: [Hot-dip galvanized-steel sheet, plastic, or rolled zinc]<Insert

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requirements>.

2. Shapes:

    a. Cornerbead.
    b. LC-Bead: J-shaped; exposed long flange receives joint compound.
    c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M requirements.

1. Mold-Resistant Joint Compound: Use mold-resistant formulations with mold-resistant panel products.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Tile Backing Panels: As recommended in writing by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints [, rounded or beveled panel edges,] and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.

    a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

D. Joint Compound for Exterior Applications:

E. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended in writing by backing panel manufacturer.

2.6 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

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B. Laminating Adhesive: Adhesive or joint compound recommended in writing by manufacturer for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C1002 unless otherwise specified or indicated on Drawings.

1. Use screws complying with ASTM C954 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 in writing by panel manufacturer.

D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers as follows:

1. Non-Fire-Resistance-Rated Assemblies: [Glass][or][slag or rock wool].
2. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
3. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent.

E. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

G. Vapor Retarder: As specified in Section 072600 "Vapor Retarders."

2.7 TEXTURE FINISHES

A. Primer: As recommended in writing by textured finish manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

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

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

A. Comply with ASTM C840 requirements.

B. Install ceiling panels across framing to minimize the number of abutting end joints and

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to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install 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.

D. 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.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support 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 structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.

J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 requirements and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

K. Install sound-attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

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3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated on Drawings.
2. On partitions/walls, apply gypsum panels [vertically (parallel to framing)][horizontally (perpendicular to framing)] unless otherwise specified or indicated on Drawings 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 panels.
    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated on Drawings or required by fire-resistance-rated assembly.

3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. 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 one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated on Drawings or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over studs or furring members and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated on Drawings or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers [and face layers separately to supports with screws][with screws; fasten face layers with adhesive and supplementary fasteners].

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

E. Curved Surfaces:

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1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

3.4 INSTALLATION OF TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at [showers, tubs, and where indicated on Drawings][locations indicated to receive tile]. Install with 1/4-inch gap where panels abut other construction or penetrations.

B. Water-Resistant Backing Board: Install where indicated with 1/4-inch gap where panels abut other construction or penetrations.

C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLATION OF TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim in accordance with manufacturer's written instructions.

B. Control Joints: Install control joints [at locations indicated on Drawings][in accordance with ASTM C840 and in specific locations approved by Architect for visual effect]<Insert requirements>.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Install at outside corners [unless otherwise specified or indicated on Drawings].
2. Bullnose Bead: Install [at outside corners][where indicated on Drawings]<Insert requirements>.
3. LC-Bead: Install [at exposed panel edges]<Insert requirements>.
4. L-Bead: Install [where indicated on Drawings]<Insert requirements>.
5. U-Bead: Install [at exposed panel edges][where indicated on Drawings]<Insert requirements>.
6. Curved-Edge Cornerbead: Install at curved openings.

D. Exterior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use [at exposed panel edges]<Insert requirements>.

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3.6 APPLICATION OF JOINT TREATMENT MATERIALS

A. Finishing Panel Products: Treat joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare panel 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 panel joints, except for trim products specifically indicated as not intended to receive tape.

D. Interior Gypsum Board: Finish panels to levels indicated below and in accordance with ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: [Panels that are substrate for tile][Panels that are substrate for acoustical tile][Where indicated on Drawings]<Insert locations>.
3. Level 3: [Where indicated on Drawings]<Insert locations>.

    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

4. Level 4: [At panel surfaces that will be exposed to view unless otherwise indicated]<Insert locations>.

    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

5. Level 5: [Where indicated on Drawings]<Insert locations>.

    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

E. Exterior Gypsum Board for Ceilings and Soffits: Finish in accordance with manufacturer's written instructions.

F. Glass-Mat Faced Panels: Finish in accordance with manufacturer's written instructions.

3.7 PROTECTION

A. Protect adjacent surfaces from joint compound and promptly remove from floors and other non-gypsum board surfaces. Repair surfaces stained, marred, or otherwise damaged during gypsum board installation and finishing.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

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1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

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SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quarry tile.
2. Porcelain tile.
3. Ceramic mosaic tile.
4. Glazed wall tile.
5. Thresholds.
6. Tile backing panels.
7. Waterproof membranes.
8. Crack isolation membranes.
9. Setting material.
10. Grout materials.

B. Related Requirements:

1. [Section 071326 "Self-Adhering Sheet Waterproofing"][Section 071353 "Elastomeric Sheet Waterproofing"][Section 071354 "Thermoplastic Sheet Waterproofing"][Section 071413 "Hot Fluid-Applied Rubberized Asphalt Waterproofing"][Section 071416 "Cold Fluid-Applied Waterproofing"] for waterproofing under thickset mortar beds.
2. Section 079200 "Joint Sealants" for sealing of movement joints in tile surfaces.
3. Section 092400 "Cement Plastering" for scratch coat for thickset mortar setting-bed installations.
4. Section 092613 "Gypsum Veneer Plastering" for cementitious backer units.
5. Section 092900 "Gypsum Board" for tile backing panels.
6. Section 093023 "Glass Tiling."
7. Section 093033 "Stone Tiling."
8. Section 096340 "Stone Flooring" for stone thresholds.

1.2 DEFINITIONS

A. General: Definitions in ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. Face Size: Actual tile size, excluding spacer lugs.

C. Large Format Tile: Tile with at least one edge 15 inches or longer.

D. Module Size: Actual tile size plus joint width indicated.

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1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]<Insert location>.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show locations, plans, and elevations, of each type of tile and tile pattern. Show widths, details, and locations of movement joints in tile substrates and finished tile surfaces. [Show thresholds.]

C. Samples for Initial Selection: For tile, grout, and accessories involving color selection or shade variation.

D. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required. [For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.][For tile with aesthetic classification V3 or V4, provide 12 tiles from same production run.]
2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least [12 inches square][36 inches square]<Insert size>, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
3. Full-size units of each type of trim and accessory [for each color and finish required].
4. Stone thresholds in 6-inch lengths.
5. Metal flooring transitions 6-inch lengths.

E. Sustainable Design Submittals:

1. Environmental Product Declaration: For each product.
2. Health Product Declaration: For each product.
3. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
4. Environmental Product Declaration: For each product.
5. Environmental Product Declaration: For each product.
6. Environmental Product Declaration: For each product.
7. Third-Party Certifications: For each product.
8. Third-Party Certified Life Cycle Assessment: For each product.
9. Product Data: For adhesives, indicating VOC content.
10. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
11. Laboratory Test Reports: For sealers, indicating compliance with requirements for low-emitting materials.

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1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

C. Product Certificates: For each type of product, including product use classification.

D. Product Test Reports:

1. Tile-setting and -grouting products.
2. Certified porcelain tile.
3. Slip-resistance test reports from qualified independent testing agency.

E. Field Quality-Control Reports: Water test reports of membrane in wet areas.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: [Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.]

a. <Insert, in separate subparagraphs, tile-type designation or description and quantity required for each category of tile for which extra material is required>.

2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is [a Five-Star member of the National Tile Contractors Association][or][a Trowel of Excellence member of the Tile Contractors' Association of America].
2. Installer's supervisor for Project holds the International Masonry Institute's Supervisor Certification.
3. Installer employs only [Ceramic Tile Education Foundation Certified Installers][or][installers recognized by the U.S. Department of Labor as Journeyman Tile Layers] for Project.
4. Installer employs at least one installer for Project that has completed the Advanced Certification for Tile Installers (ACT) certification for installation of [mud floors][mud walls][membranes][shower receptors][and][large format tile].

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1.8 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of [each type of] floor tile installation.
2. Build mockup of [each type of] wall tile installation.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

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

D. Store liquid materials in unopened containers and protected from freezing.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.11 WARRANTY

A. System Warranty: Manufacturer's non-prorated comprehensive warranty that agrees to repair and replace defective installation areas, material, and labor that fail under normal usage within specified warranty period.

1. Warranty Period: [Five years][10 years][25 years][Lifetime] from date of Product Purchase.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Tile: Obtain [tile of each type and color or finish][tile of each type][tile of each color or finish][tile] from single source or producer.

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1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Accessory Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Stone thresholds.
2. Backer units.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard Grade requirements [unless otherwise indicated].

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

1. Where tile is indicated for installation [in swimming pools][on exteriors][or][in wet areas], do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.3 QUARRY TILE

2.4 PORCELAIN TILE

2.5 CERAMIC MOSAIC TILE

2.6 GLAZED WALL TILE

A. Accessories: Provide vitreous china accessories of type and size indicated; suitable for installing by same method as used for adjoining wall tile.

1. One soap holder [with grab handle] for each shower and tub indicated.

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2. One paper holder at each water closet.
3. Color and Finish: As selected by Architect from manufacturer's full range.

2.7 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

B. Granite Thresholds: ASTM C615/C615M, with polished finish.

1. Description:

a. Uniform, fine -grained, white stone without veining.
b. Match Architect's sample.
c. Provide [one of] the following:

1) <Insert, in separate subparagraphs, name of variety and producer, distributor, or importer>.

C. Marble Thresholds: ASTM C503/C503M, with a minimum abrasion resistance of 10 in accordance with ASTM C1353/C1353M or ASTM C241/C241M and with honed finish.

1. Description:

a. Uniform, fine- to medium-grained white stone with gray veining.
b. Match Architect's sample.
c. Provide [one of] the following:

2.8 WATERPROOF MEMBRANES

A. General: Manufacturer's standard product [, selected from the following,] that complies with ANSI A118.10 [and ANSI A118.12] and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.

2.9 CRACK ISOLATION MEMBRANES

A. General: Manufacturer's standard product [, selected from the following,] that complies with ANSI A118.12 for [standard performance][high performance] and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.

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2.10 SETTING MATERIALS

A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.

1. Cleavage Membrane: Installer's option of material that complies with ANSI A108.02, paragraph 3.8.
2. Reinforcing Wire Fabric: Galvanized, welded-wire fabric, 2 by 2 inches by 0.062-inch diameter; comply with ASTM A1064/A1064M except for minimum wire size.
3. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.

2.11 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

B. Grout for Pregrouted Tile Sheets: Same product used in factory to pregrout tile sheets.

2.12 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting and adhesive materials for installations indicated.

B. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D4397, 4.0 mils thick.

C. Temporary Protective Coating: Formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products and easily removable after grouting is completed without damaging grout or tile.

D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

E. Grout Sealer: Grout manufacturer's standard product for sealing grout joints that does not change color or appearance of grout.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are

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incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Verify that concrete substrates for tile floors installed with [adhesives][bonded mortar bed][or][thinset mortar] comply with surface finish requirements in ANSI A108.01 for installations indicated.

    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

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

3.2 PREPARATION

A. Remove coatings, including curing compounds or other coatings, that are incompatible with tile-setting materials.

B. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with [adhesives][or][thinset mortar] with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

C. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1 and is sloped 1/4 inch per foot toward drains.

D. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

E. Substrate Flatness:

1. For tile shorter than 15 inches, confirm that structure or substrate is limited to variation of 1/4 inch in 10 ft. from the required plane, and no more than 1/16 inch in 12 inches when measured from tile surface high points.
2. For large format tile, tile with at least one edge 15 inches or longer, confirm that structure or substrate is limited to 1/8 inch in 10 ft. from the required plane, and no more than 1/16 inch in 24 inches when measured from tile surface high points.

F. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with

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continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 INSTALLATION OF CERAMIC TILE SYSTEM

A. Install tile backing panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

B. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

1. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

C. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

1. Allow crack isolation membrane to cure before installing tile or setting materials over it.

D. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

1. Add materials, water, and additives in accurate proportions.
2. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

E. Install tile in accordance with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 series that are referenced in TCNA installation methods and specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

a. Exterior tile floors and walls.
b. Tile floors in wet areas.
c. Tile swimming pool decks.
d. Tile floors in laundries.
e. Tile floors consisting of tiles 8 by 8 inches or larger.
f. Tile floors consisting of rib-backed tiles.

2. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

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3. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
4. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
5. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
6. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

    a. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets, so joints between sheets are not apparent in finished Work.
    b. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
    c. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

7. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

F. Movement Joints: Provide movement joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated on Drawings. Form joints during installation of setting materials, mortar beds, and tile. Keep joints free of dirt, debris, and setting materials prior to filling with sealants. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

G. Thresholds: Install stone and solid surface thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in [modified dry-set][improved modified dry-set] mortar (thinset).
2. Do not extend [cleavage membrane][waterproof membrane][or][crack isolation membrane] under thresholds set in [standard dry-set][modified dry-set][or][improved modified dry-set] mortar. Fill joints between such thresholds and adjoining tile set on [cleavage membrane][waterproof membrane][or][crack isolation membrane] with elastomeric sealant.

H. Metal Wall Trim: Install at locations indicated on Drawings.

I. Grout Sealer: Apply grout sealer to [cementitious] grout joints [in tile floors] in

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accordance with manufacturer's written instructions. As soon as sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 FIELD QUALITY CONTROL

A. Water Test:

1. Test of waterproofing membrane in showers and similar areas to be performed by Installation Contractor before setting tile.

    a. Perform test after 24 hours of waterproof membrane installation.
    b. Insert test plug in drain or waste line.
    c. Fill shower base with water, high enough that the membrane-to-drain connection and floor-to-wall transition can be evaluated, and mark wall.
    d. Check for leaks after 24 hours.

2. Test to be witnessed by [Architect][authorities having jurisdiction]<Insert names or titles of witnesses>.

B. Nonconforming Work:

1. Waterproof membrane will be considered defective if water level has dropped.
2. Remove and replace defective components and retest.

3.5 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile in accordance with tile and grout manufacturer's written instructions. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.6 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is

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completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.7 EXTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Exterior Floor Installations:

1. TCNA F101 <Insert designation>: Method [ANSI A108.1A][ANSI A108.1B][ANSI A108.1C]. Cement mortar bed (thickset) [bonded to concrete][over waterproof membrane on concrete][over waterproof membrane on concrete where indicated and bonded to concrete where membrane is not indicated].

    a. Ceramic Tile Type: <Insert tile-type designation>.
    b. Bond Coat for Cured-Bed Method: [Dry-set][Modified dry-set][Improved modified dry-set] mortar.
    c. Grout: [Sand-portland cement][Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement] grout.
    d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid applied][Fabric reinforced, fluid applied].
    e. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
    f. Movement Joints: Types located on Drawings.

2. TCNA F102 <Insert designation>: Thinset mortar [on concrete][over waterproof membrane on concrete][over waterproof membrane on concrete where indicated and on concrete where membrane is not indicated][over crack isolation membrane on concrete][over crack isolation membrane on concrete where indicated and on concrete where membrane is not indicated].

    a. Ceramic Tile Type: <Insert tile-type designation>.
    b. Thinset Mortar: [Dry-set][Modified dry-set][Improved modified dry-set] mortar.
    c. Grout: [Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement] grout.
    d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
    e. Crack Isolation Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Asphaltic sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
    f. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
    g. Movement Joints: Types located on Drawings.

B. Exterior Roof/Deck Floor Installations:

1. TCNA F103 <Insert designation>: Method [ANSI A108.1A][ANSI A108.1B][ANSI A108.1C]. Cement mortar bed (thickset) [over waterproof membrane on

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concrete][over waterproof membrane on concrete where indicated and on concrete where membrane is not indicated] over drainage material on roof membrane.

a. Ceramic Tile Type: <Insert tile-type designation>.
b. Bond Coat for Cured-Bed Method: [Modified dry-set][Improved modified dry-set] mortar.
c. Grout: [Sand-portland cement][Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement] grout.
d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
e. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
f. Movement Joints: Types located on Drawings.

2. TCNA F104 <Insert designation>: Thinset mortar [on concrete][over waterproof membrane on concrete][over waterproof membrane on concrete where indicated and on concrete where membrane is not indicated][over crack isolation membrane on concrete][over crack isolation membrane on concrete where indicated and on concrete where membrane is not indicated].

a. Ceramic Tile Type: <Insert tile-type designation>.
b. Thinset Mortar: [Modified dry-set][Improved modified dry-set] mortar.
c. Grout: [Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement] grout.
d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
e. Crack Isolation Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Asphaltic sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
f. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
g. Movement Joints: Types located on Drawings.

C. Exterior Wall Installations, Masonry or Concrete:

1. TCNA W201 <Insert designation>: Method [ANSI A108.1A][ANSI A108.1B][ANSI A108.1C]. Cement mortar bed (thickset) installed on metal lath [over waterproof membrane][over water-resistant barrier][over vapor-retarder membrane].

a. Ceramic Tile Type: <Insert tile-type designation>.
b. Bond Coat for Cured-Bed Method: [Modified dry-set][Improved modified dry-set] mortar.
c. Grout: [Sand-portland cement][Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement] grout.
d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].

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e. Water-Resistive Barrier: Compliant with local code requirements [and][specified in Division 07].
f. Vapor Retarder: Compliant with local code requirements [and][specified in Division 07].
g. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
h. Movement Joints: Types located on Drawings.

2. TCNA W202E <Insert designation>: Thinset mortar [over waterproof membrane][over water-resistive barrier][over vapor retarder membrane].

a. Ceramic Tile Type: <Insert tile-type designation>.
b. Thinset Mortar: [Dry-set][Modified dry-set][Improved modified dry-set] mortar.
c. Grout: [Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement] grout.
d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
e. Water-Resistive Barrier: Compliant with local code requirements [and][specified in Division 07].
f. Vapor Retarder: Compliant with local code requirements [and][specified in Division 07].
g. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
h. Movement Joints: Types located on Drawings.

D. Exterior Wall Installations, Wood or Metal Studs:

1. TCNA W244E <Insert designation>: Thinset mortar [over waterproof membrane on cementitious backer units][on cementitious backer units over vapor-retarder membrane][on cementitious backer units over water-resistive barrier].

a. Ceramic Tile Type: <Insert tile-type designation>.
b. Thinset Mortar: [Dry-set][Modified dry-set][Improved modified dry-set] mortar.
c. Grout: [Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement] grout.
d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
e. Water-Resistive Barrier: Compliant with local code requirements [and][specified in Division 07].
f. Vapor Retarder: Compliant with local code requirements [and][specified in Division 07].
g. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
h. Movement Joints: Types located on Drawings.

3.8 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

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1. TCNA F111 <Insert designation>: Method [ANSI A108.1A][ANSI A108.1B][ANSI A108.1C]. Cement mortar bed (thickset) installed over cleavage membrane.

    a. Ceramic Tile Type: <Insert tile-type designation>.
    b. Bond Coat for Cured-Bed Method: [Dry-set][Modified dry-set][Improved modified dry-set] mortar.
    c. Grout: [Sand-portland cement][Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement] grout.
    d. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
    e. Movement Joints: Types located on Drawings.

2. TCNA F125-Full <Insert designation>: Thinset mortar on crack isolation membrane.

    a. Ceramic Tile Type: <Insert tile-type designation>.
    b. Thinset Mortar: [Modified dry-set][Improved modified dry-set] mortar.
    c. Grout: [Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement][Water-cleanable epoxy] grout.
    d. Crack Isolation Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Asphaltic sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
    e. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
    f. Movement Joints: Types located on Drawings.

B. Interior Floor Installations, Wood Subfloor:

1. TCNA F141 <Insert designation>: Method [ANSI A108.1A][ANSI A108.1B][ANSI A108.1C]. Cement mortar bed (thickset) installed over cleavage membrane [over waterproof membrane].

    a. Ceramic Tile Type: <Insert tile-type designation>.
    b. Bond Coat for Cured-Bed Method: [Dry-set][Modified dry-set][Improved modified dry-set] mortar.
    c. Grout: [Sand-portland cement][Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement][Water-cleanable epoxy] grout.
    d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
    e. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
    f. Movement Joints: Types located on Drawings.

2. TCNA F142 <Insert designation>: Organic adhesive on plywood underlayment.

    a. Ceramic Tile Type: <Insert tile-type designation>.
    b. Grout: [Sand-portland cement][Standard sanded cement][Standard unsanded cement][High-performance sanded][High-performance unsanded][Water-cleanable epoxy] grout.

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c. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
d. Movement Joints: Types located on Drawings.

C. Interior Radiant Heat Floor Installations, Concrete Subfloor:

1. TCNA RH110 <Insert designation>: Thinset mortar [on crack isolation membrane]; hydronic piping installed in concrete.

a. Ceramic Tile Type: <Insert tile-type designation>.
b. Thinset Mortar: [Modified dry-set][Improved modified dry-set] mortar.
c. Grout: [Sand-portland cement][Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement][Water-cleanable epoxy] grout.
d. Crack Isolation Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Asphaltic sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
e. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
f. Movement Joints: Types located on Drawings.

2. TCNA RH115 <Insert designation>: Thinset mortar; electric radiant system encapsulated in thinset mortar.

a. Ceramic Tile Type: <Insert tile-type designation>.
b. Thinset Mortar: [Modified dry-set][Improved modified dry-set] mortar.
c. Grout: [Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement][Water-cleanable epoxy] grout.
d. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
e. Movement Joints: Types located on Drawings.

D. Interior Radiant Heat Floor Installations, Wood Subfloor:

1. TCNA RH130 <Insert designation>: Thinset mortar on exterior-glue plywood; electric radiant system encapsulated in thinset mortar.

a. Ceramic Tile Type: <Insert tile-type designation>.
b. Thinset Mortar: [EGP (exterior glue plywood) latex-portland cement][Modified dry-set][Improved modified dry-set] mortar.
c. Grout: [Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement][Water-cleanable epoxy] grout.
d. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
e. Movement Joints: Types located on Drawings.

2. TCNA RH141 <Insert designation>: Method [ANSI A108.1A][ANSI A108.1B][ANSI A108.1C]. Cement mortar bed (thickset) installed over cleavage membrane [and waterproof membrane] with hydronic piping installed in mortar bed.

a. Ceramic Tile Type: <Insert stone tile-type designation>.
b. Bond Coat for Cured-Bed Method: [Modified dry-set][Improved modified

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dry-set] mortar.
c. Grout: [Sand-portland cement][Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement][Water-cleanable epoxy] grout.
d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
e. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
f. Movement Joints: Types located on Drawings.

E. Interior Wall Installations, Masonry or Concrete:

1. TCNA W202I <Insert designation>: Thinset mortar [over waterproof membrane].

a. Ceramic Tile Type: <Insert tile-type designation>.
b. Thinset Mortar: [Dry-set][Modified dry-set][Improved modified dry-set][Water-cleanable epoxy] mortar.
c. Grout: [Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement][Water-cleanable epoxy] grout.
d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
e. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
f. Movement Joints: Types located on Drawings.

2. TCNA W211 <Insert designation>: Method [ANSI A108.1A][ANSI A108.1B][ANSI A108.1C]. Cement mortar bed (thickset) bonded to substrate [over waterproof membrane].

a. Ceramic Tile Type: <Insert tile-type designation>.
b. Bond Coat for Cured-Bed Method: [Dry-set][Modified dry-set][Improved modified dry-set] mortar.
c. Grout: [Sand-portland cement][Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement][Water-cleanable epoxy] grout.
d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
e. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
f. Movement Joints: Types located on Drawings.

F. Interior Wall Installations, Wood or Metal Studs or Furring:

1. TCNA W242 <Insert designation>: Organic adhesive on gypsum board.

a. Ceramic Tile Type: <Insert tile-type designation>.
b. Grout: [Sand-portland cement][Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement][Water-cleanable epoxy] grout.

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c. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
d. Movement Joints: Types located on Drawings.

2. TCNA W245 <Insert designation>: Thinset mortar on glass-mat, water-resistant gypsum backer board [over waterproof membrane].

a. Ceramic Tile Type: <Insert tile-type designation>.
b. Thinset Mortar: [Dry-set][Modified dry-set][Improved modified dry-set] mortar.
c. Grout: [Sand-portland cement][Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement][Water-cleanable epoxy] grout.
d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
e. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
f. Movement Joints: Types located on Drawings.

G. Bathtub Wall Installations with No Shower Head, Wood or Metal Studs or Furring:

1. TCNA B413 <Insert designation>: [Thinset mortar][Organic adhesive] on [water-resistant gypsum][coated glass-mat, water-resistant gypsum] backer board.

a. Ceramic Tile Type: <Insert tile-type designation>.
b. Thinset Mortar: [Dry-set][Modified dry-set][Improved modified dry-set] mortar.
c. Grout: [Sand-portland cement][Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement][Water-cleanable epoxy] grout.
d. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
e. Movement Joints: Types located on Drawings.

H. Bathtub/Shower Wall Installations:

1. TCNA B419 <Insert designation>: Thinset mortar [over waterproof membrane] on coated glass-mat, water-resistant gypsum backer board.

a. Ceramic Tile Type: <Insert tile-type designation>.
b. Thinset Mortar: [Modified dry-set][Improved modified dry-set] mortar.
c. Grout: [Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement][Water-cleanable epoxy] grout.
d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
e. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
f. Movement Joints: Types located on Drawings.

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3.9 CHEMICAL-RESISTANT TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete:

1. TCNA F115 <Insert designation>: Thinset mortar [over crack isolation membrane].

a. Chemical-Resistant Tile Type: <Insert tile-type designation>.
b. Thinset Mortar: [Dry-set][Modified dry-set][Improved modified dry-set] mortar.
c. Grout: [Water-cleanable epoxy][Chemical-resistant furan].
d. Crack Isolation Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Asphaltic sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
e. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
f. Movement Joints: Types located on Drawings.

2. TCNA F131 <Insert designation>: Water-cleanable, tile-setting epoxy.

a. Chemical-Resistant Tile Type: <Insert tile-type designation>.
b. Grout: Water-cleanable epoxy.
c. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
d. Movement Joints: Types located on Drawings.

B. Interior Wall Installations, Masonry or Concrete:

1. TCNA W211 <Insert designation>: Method [ANSI A108.1A][ANSI A108.1B][ANSI A108.1C]. Cement mortar bed (thickset) bonded to substrate [over waterproof membrane].

a. Chemical-Resistant Tile Type: <Insert tile-type designation>.
b. Bond Coat for Cured-Bed Method: [Dry-set][Latex-] portland cement mortar.
c. Grout: Water-cleanable epoxy.
d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
e. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
f. Movement Joints: Types located on Drawings.

C. Interior Wall Installations, Solid Backing:

1. TCNA W222 <Insert designation>: Method [ANSI A108.1A][ANSI A108.1B][ANSI A108.1C]. One-coat cement mortar bed (thickset) installed [over cleavage membrane][over waterproof membrane] on solid backing.

a. Chemical-Resistant Tile Type: <Insert tile-type designation>.
b. Bond Coat for Cured-Bed Method: [Dry-set][Modified dry-set][Improved modified dry-set] mortar.
c. Grout: Water-cleanable epoxy.
d. Waterproof Membrane: [As recommended by setting material

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manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].

e. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.

f. Movement Joints: Types located on Drawings.

END OF SECTION 093013

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SECTION 093033 - STONE TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Granite tile.
2. Limestone tile.
3. Marble tile.
4. Quartz-based tile.
5. Slate tile.
6. Travertine tile.
7. Thresholds.

B. Related Requirements:

1. [Section 035413 "Gypsum Cement Underlayment"][035416 "Hydraulic Cement Underlayment"] for application below interior floor coverings.
2. [Section 071326 "Self-Adhering Sheet Waterproofing"][Section 071353 "Elastomeric Sheet Waterproofing"][Section 071354 "Thermoplastic Sheet Waterproofing"][Section 071413 "Hot Fluid-Applied Rubberized Asphalt Waterproofing"][Section 071416 "Cold Fluid-Applied Waterproofing"] for waterproofing under thickset mortar beds.
3. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in stone tile surfaces.
4. Section 092400 "Cement Plastering" for scratch coat over metal lath on wall surfaces.
5. Section 092613 "Gypsum Veneer Plastering" for cementitious backer units.
6. Section 092900 "Gypsum Board" for tile backing panels.
7. Section 096340 "Stone Flooring" for dimension stone flooring other than thin modular dimension stone tile.
8. Section 097519 "Stone Trim" for stone base in the form of running trim rather than tile.

1.2 DEFINITIONS

A. General: Definitions in ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. Dimension Stone Tile: Modular stone that has been selected and stock fabricated into units less than 3/4 inch thick without any facial dimensions greater than 2 ft..

C. Module Size: Actual tile size plus joint width indicated.

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1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]<Insert location>.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Granite tile.
2. Limestone tile.
3. Marble tile.
4. Quartz-based tile
5. Slate tile.
6. Travertine tile.
7. Thresholds.
8. Tile backing panels.
9. Waterproof membranes.
10. Crack isolation membranes.
11. Setting materials.
12. Grout materials.

B. Shop Drawings: Show locations of each type of stone tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in substrates and finished stone tile surfaces. [Show stone thresholds.]

C. Samples for Initial Selection: For tile, grout, and accessories involving color selection.

D. Samples for Verification:

1. Full-size units of each type of stone tile [in each finish required].
2. Assembled Samples with grouted joints for each type of stone tile [and for each finish required], at least [36 inches square]<Insert size> and mounted on a rigid panel. Use grout of type and in color(s) approved for completed Work.
3. Range Samples consisting of at least [two][three][four][five]<Insert number> full-size units of each type of stone tile, exhibiting extremes of the full range of color and other visual characteristics expected. Range Samples establish the standard by which individual stone tiles [and thresholds] are judged.
4. Stone thresholds in 6-inch lengths.
5. Metal flooring transitions in 6-inch lengths.

E. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party Certified Life Cycle Assessment: For each product.

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1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports:

1. Tile-setting and -grouting products.
2. Slip-resistance test reports from qualified independent testing agency.

C. Field Quality-Control Reports: Water test reports of membrane in wet areas.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials, from same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Dimension Stone Tile: [Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.]

a. <Insert, in separate subparagraphs, stone tile-type designation or description and quantity required for each category of stone tile for which extra material is required>.

2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is [a Five-Star member of the National Tile Contractors Association][or][a Trowel of Excellence member of the Tile Contractors' Association of America].
2. Installer's supervisor for Project holds the International Masonry Institute's Supervisor Certification.
3. Installer employs only [Ceramic Tile Education Foundation Certified Installers][or][installers recognized by the U.S. Department of Labor as Journeyman Tile Layers] for Project.
4. Installer employs at least one installer for Project that has completed the Advanced Certification for Tile Installers (ACT) certification for installation of [mud floors][mud walls][membranes][shower receptors][and][large format tile].

1.8 MOCKUPS

A. Build [dry-laid] mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup [as indicated on Drawings]<Insert mockup requirements>.

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2. Maintain dry-laid mockups in an undisturbed condition until equivalent areas of the completed Work are approved to serve as mockups.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store stone tile and cementitious materials on elevated platforms, under cover, and in a dry location.

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

D. Store liquid materials in unopened containers and protected from freezing.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not install stone tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.11 WARRANTY

A. System Warranty: Manufacturer's non-prorated comprehensive warranty that agrees to remove and replace defective installation areas, material and labor, that fail under normal usage within specified warranty period.

1. Warranty Period: [Five years][10 years][25 years][Lifetime] from date of [Product Purchase][Substantial Completion].

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Stone Tile: Obtain [tile of each type and color or finish][tile of each type][tile of each color or finish][tile] from single source or producer.

1. Where two or more stone product types are identical, except for size or finish, provide same variety for each type.
2. Where threshold types are identical to stone tile types, except for size or finish, provide same variety.

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B. Accessory Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Stone thresholds.
2. Backer units.

2.2 PRODUCTS, GENERAL

A. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

B. Pattern Orientation: For stone varieties with a directional pattern, provide tile with pattern [oriented parallel to one side of tile][randomly oriented at various angles to sides of tiles].

1. For stone varieties that exhibit a directional pattern, provide thresholds with pattern [oriented parallel to][oriented at an angle of 45 degrees or less to][randomly oriented at various angles to] long edges of thresholds.

2.3 GRANITE TILE

A. Granite Tile Type :

1. Varieties and Sources: Subject to compliance with requirements, [provide the following:][provide one of the following:][match Architect's sample for color, finish, and other characteristics relating to aesthetic effects.]

a. <Insert manufacturer and tile names and modular sizes>.

2. Module Size:
[4 by 4 inches][6 by 6 inches][8 by 8 inches][24 by 24 inches]<Insert size>.
3. Nominal Thickness: [3/8 inch][1/2 inch]<Insert thickness>.
4. Abrasion Resistance of Stone Tile for Floors: Provide stone with a value of not less than [12][25]<Insert number> in accordance with ASTM C1353/C1353M or ASTM C241/C241M.
5. Product Use Classification: [Interior, Dry (ID)][Interior, Wet (IW)][Interior, Wet Plus (IW+)][Exterior, Wet (EW)][Oil/Greases (O/G)].

2.4 LIMESTONE TILE

A. Limestone Tile Type :

1. Varieties and Sources: Subject to compliance with requirements, [provide the following:][provide one of the following:][match Architect's sample for color, finish, and other characteristics relating to aesthetic effects.]

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a. <Insert manufacturer and tile names and modular sizes>.

2. Module Size:
[4 by 4 inches][6 by 6 inches][8 by 8 inches][24 by 24 inches]<Insert size>.
3. Nominal Thickness: [3/8 inch][1/2 inch]<Insert thickness>.
4. Abrasion Resistance of Stone Tile for Floors: Provide stone with a value of not less than [10][12]<Insert number> in accordance with ASTM C1353/C1353M or ASTM C241/C241M.
5. Product Use Classification: [Interior, Dry (ID)][Interior, Wet (IW)][Interior, Wet Plus (IW+)][Exterior, Wet (EW)][Oil/Greases (O/G)].

2.5 MARBLE TILE

A. Marble Tile Type :

1. Varieties and Sources: Subject to compliance with requirements, [provide the following:][provide one of the following:][match Architect's sample for color, finish, and other characteristics relating to aesthetic effects.]

a. <Insert manufacturer and tile names and modular sizes>.

2. Module Size:
[4 by 4 inches][6 by 6 inches][8 by 8 inches][24 by 24 inches]<Insert size>.
3. Nominal Thickness: [3/8 inch][1/2 inch]<Insert thickness>.
4. Abrasion Resistance of Stone Tile for Floors: Provide stone with a value of not less than [10][12]<Insert number> in accordance with ASTM C1353/C1353M or ASTM C241/C241M.
5. Product Use Classification: [Interior, Dry (ID)][Interior, Wet (IW)][Interior, Wet Plus (IW+)][Exterior, Wet (EW)][Oil/Greases (O/G)].

2.6 QUARTZ-BASED TILE

A. Quartz-Based Tile Type :

1. Varieties and Sources: Subject to compliance with requirements, [provide the following:][provide one of the following:][match Architect's sample for color, finish, and other characteristics relating to aesthetic effects.]

a. <Insert manufacturer and tile names and modular sizes>.

2. Module Size:
[4 by 4 inches][6 by 6 inches][8 by 8 inches][24 by 24 inches]<Insert size>.
3. Nominal Thickness: [3/8 inch][1/2 inch]<Insert thickness>.
4. Abrasion Resistance of Stone Tile for Floors: Provide stone with a value of not less than [8][12]<Insert number> in accordance with ASTM C1353/C1353M or ASTM C241/C241M.
5. Product Use Classification: [Interior, Dry (ID)][Interior, Wet (IW)][Interior, Wet Plus (IW+)][Exterior, Wet (EW)][Oil/Greases (O/G)].

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2.7 SLATE TILE

A. Slate Tile Type :

1. Varieties and Sources: Subject to compliance with requirements, [provide the following:][provide one of the following:][match Architect's sample for color, finish, and other characteristics relating to aesthetic effects.]

    a. <Insert manufacturer and tile names and modular sizes>.

2. Module Size:
   [4 by 4 inches][6 by 6 inches][8 by 8 inches][18 by 24 inches]<Insert size>.
3. Nominal Thickness: [3/8 inch][1/2 inch]<Insert thickness>.
4. Abrasion Resistance of Stone Tile for Floors: Provide stone with a value of not less than [8][10]<Insert number> in accordance with ASTM C1353/C1353M or ASTM C241/C241M.
5. Product Use Classification: [Interior, Dry (ID)][Interior, Wet (IW)][Interior, Wet Plus (IW+)][Exterior, Wet (EW)][Oil/Greases (O/G)].

2.8 TRAVERTINE TILE

A. Travertine Tile Type :

1. Varieties and Sources: Subject to compliance with requirements, [provide the following:][provide one of the following:][match Architect's sample for color, finish, and other characteristics relating to aesthetic effects.]

    a. <Insert, manufacturer and tile names and modular sizes>.

2. Module Size:
   [4 by 4 inches][6 by 6 inches][8 by 8 inches][18 by 24 inches]<Insert size>.
3. Nominal Thickness: [3/8 inch][1/2 inch]<Insert thickness>.
4. Abrasion Resistance of Stone Tile for Floors: Provide stone with a value of not less than [10][12]<Insert number> in accordance with ASTM C1353/C1353M or ASTM C241/C241M.
5. Product Use Classification: [Interior, Dry (ID)][Interior, Wet (IW)][Interior, Wet Plus (IW+)][Exterior, Wet (EW)][Oil/Greases (O/G)].

2.9 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

B. Granite Thresholds: ASTM C615/C615M, with [polished][honed]<Insert finish> finish.

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1. Description:

    a. Uniform, [fine][medium] -grained, [white][gray][black]<Insert color> stone without veining.
    b. Match Architect's sample.
    c. Match adjacent stone tile flooring.
    d. Provide [one of] the following:

        1) <Insert, in separate subparagraphs, name of variety and producer, distributor, or importer>.

C. Marble Thresholds: ASTM C503/C503M, with a minimum abrasion resistance of [10][12] in accordance with ASTM C1353/C1353M or ASTM C241/C241M and with honed finish.

    1. Description:

        a. Uniform, fine- to medium-grained white stone with gray veining.
        b. Match Architect's sample.
        c. Match adjacent stone tile flooring.
        d. Provide [one of] the following:

            1) <Insert, in separate subparagraphs, name of variety and producer, distributor, or importer>.

D. Slate Thresholds: ASTM C629/C629M, Classification [I Exterior][II Interior], with fine, even grain and honed finish.

    1. Description:

        a. Uniform, [black][blue-black][gray][blue-gray][green]<Insert color> stone [and unfading].
        b. Match Architect's sample.
        c. Match adjacent stone tile flooring.
        d. Provide [one of] the following:

            1) <Insert, in separate subparagraphs, name of variety and producer, distributor, or importer>.

E. Solid Surface Thresholds: Homogeneous-filled plastic resin complying with ISFA-02-01.

    1. Description:

        a. Type: Provide [Standard][Special Purpose] type.
        b. Colors and Patterns: [As indicated by manufacturer's designations][Match Architect's samples][As selected by Architect from manufacturer's full range].

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2.10 WATERPROOF MEMBRANES

A. General: Manufacturer's standard product [, selected from the following,] that complies with ANSI A118.10 [and ANSI A118.12] and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

2.11 CRACK ISOLATION MEMBRANES

A. General: Manufacturer's standard product [, selected from the following,] that complies with ANSI A118.12 for [standard performance][high performance] and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

2.12 SETTING MATERIALS

A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.

1. Cleavage Membrane: Installer's option of material that complies with ANSI A108.02, paragraph 3.8.
2. Reinforcing Wire Fabric: Galvanized, welded-wire fabric, 2 by 2 inches by 0.062 inch in diameter; comply with ASTM A1064/A1064M except for minimum wire size.
3. Expanded Metal Lath: Diamond-mesh lath complying with ASTM C847.

    a. Base Metal and Finish for Interior Applications: Uncoated or zinc-coated (galvanized) steel sheet, with uncoated steel sheet painted after fabrication into lath.
    b. Base Metal and Finish for Exterior Applications: Zinc-coated (galvanized) steel sheet.
    c. Configuration over Studs and Furring: Flat.
    d. Configuration over Solid Surfaces: Self furring.
    e. Weight: [2.5 lb/sq. yd.][3.4 lb/sq. yd.].

4. Latex Additive: [Manufacturer's standard][acrylic resin][or][styrene-butadiene-rubber] water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.

2.13 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

2.14 MISCELLANEOUS MATERIALS

A. Trowelable Underlayment and Patching Compounds: Latex-modified, portland cement-

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based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D4397, 4.0 mils thick.

C. Temporary Protective Coating: Formulated to protect exposed surfaces of stone tile against adherence of mortar and grout; compatible with stone, mortar, and grout products and easily removable after grouting is completed without damaging grout or stone tile.

D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming stone tile and grout surfaces, specifically approved for materials and installations indicated by stone tile producers and grout manufacturers.

E. Grout Sealer: Grout manufacturer's standard product for stone type and application indicated that does not change color or appearance of grout.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where stone tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting stone tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for stone tile floors installed with [adhesives][bonded mortar bed][or][thinset mortar] comply with surface finish requirements in ANSI A108.01 for installations indicated.

    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind stone tile has been completed.
4. Verify that joints and cracks in stone tile substrates are coordinated with stone tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

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

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3.2 PREPARATION

A. Remove coatings, including curing compounds or other coatings, that are incompatible with tile-setting materials.

B. Fill cracks, holes, and depressions in concrete substrates for stone tile floors installed with [adhesives][or][thinset mortar] with trowelable patching compound specifically recommended by tile-setting material manufacturer.

C. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

D. Lay out stone tile patterns by marking joint lines on substrates to verify joint placement at edges, corners, doors, and other critical elements.

1. Notify Architect seven days in advance of dates and times when layout will be done.
2. Obtain Architect's approval of layout before starting stone tile installation.

E. Lay out stone tiles on substrates or on an adjacent surface to establish placement of individual stone tiles for balance of color and pattern variations.

1. Notify Architect seven days in advance of dates and times when layout will be done.
2. Architect may relocate specific stone tiles with other stone tiles of same type and will determine final location of each stone tile within indicated patterns.
3. Identify each stone tile with a temporary number marked on face of stone tile that corresponds with an identical number marked on a layout drawing, and obtain Architect's approval before starting stone tile installation.

F. Substrate Flatness:

1. For stone tile shorter than 15 inches, confirm that structure or substrate is limited to variation of 1/4 inch in 10 ft. from the required plane, and no more than 1/6 inch in 12 inches when measured from tile surface high points.
2. For stone tile with at least one edge 15 inches or longer, confirm that structure or substrate is limited to 1/8 inch in 10 ft. from the required plane, and no more than 1/6 inch in 24 inches when measured from tile surface high points.

G. Field-Applied Temporary Protective Coating: If indicated under stone tile type or needed to prevent grout from staining or adhering to exposed stone tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed stone tile surfaces.

3.3 INSTALLATION OF STONE TILE SYSTEM

A. Install tile backing panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

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B. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

1. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

C. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

1. Allow crack isolation membrane to cure before installing tile or setting materials over it.

D. Mix mortars and grouts to comply with "Referenced Standards" Article in the Evaluations and mortar and grout manufacturers' written instructions.

1. Add materials, water, and additives in accurate proportions.
2. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

E. Install stone tile in accordance with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in stone tile installation schedules. Comply with parts of the ANSI A108 series that are referenced in TCNA installation methods specified in stone tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

   a. Exterior stone tile floors and walls.
   b. Stone tile floors in wet areas.
   c. Stone tile floors consisting of stone tiles 8 by 8 inches or larger.

2. Wipe backs of stone tiles with a damp cloth to remove dirt and dust before units are installed.
3. Extend stone tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
4. Accurately form intersections and returns. Perform cutting and drilling of stone tile without marring visible surfaces. Carefully grind cut edges of stone tile abutting trim, finish, or built-in items for straight aligned joints. Fit stone tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap stone tile.
5. Finish cut stone tile edges that will not be concealed by other construction by grinding and honing cut surfaces [and beveling edges][and easing edges] to match factory-fabricated edges [unless otherwise indicated].
6. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

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7. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
8. Jointing Pattern: Lay stone tile in grid pattern unless otherwise indicated. Lay out stone tile work and center stone tile fields in both directions in each space or on each wall area. Lay out stone tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

    a. Where adjoining stone tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
    b. Where stone tiles are specified or indicated to be whole integer multiples of adjoining stone tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

9. Lay out stone tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
10. Match stone tiles within each space by selecting tiles to achieve uniformity of color and pattern. Reject or relocate stone tiles that do not match color and pattern of adjacent tiles.
11. Mix stone tiles to achieve a uniformly random distribution of color shadings and patterns.
12. Pattern Orientation: For stone varieties with directional pattern, orient pattern as [indicated on Drawings][directed by Architect].

F. Movement Joints: Provide movement joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated on Drawings. Form joints during installation of setting materials, mortar beds, and stone tile. Keep joints free of dirt, debris, and setting materials prior to filling with sealants. Do not saw-cut joints after installing stone tiles.

    1. Where joints occur in concrete substrates, locate joints in stone tile surfaces directly above them.

G. Thresholds: Install stone and solid surface thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

    1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in [modified dry-set][improved modified dry-set] mortar (thinset).
    2. Do not extend [cleavage membrane][waterproof membrane][or][crack isolation membrane] under thresholds set in [standard dry-set][modified dry-set][improved modified dry-set] mortar. Fill joints between such thresholds and adjoining stone tile with elastomeric sealant.

H. Metal Wall Trim: Install at locations indicated on Drawings.

I. Grout Sealer: Apply grout sealer to [cementitious] grout joints [in tile floors] in accordance with manufacturer's written instructions. As soon as sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

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3.4 FIELD QUALITY CONTROL

A. Water Test:

1. Test of waterproofing membrane in showers and similar areas to be performed by Installation Contractor before setting tile.

    a. Perform test after 24 hours of waterproof membrane installation.
    b. Insert test plug in drain or waste line.
    c. Fill shower base with water, high enough that the membrane-to-drain connection and floor-to-wall transition can be evaluated, and mark wall.
    d. Check for leaks after 24 hours.

2. Test to be witnessed by [Architect][authorities having jurisdiction]<Insert names or titles of witnesses>.

B. Nonconforming Work:

1. Waterproof membrane will be considered defective if water level has dropped.
2. Remove and replace defective components and retest.

3.5 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining stone tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean stone tile surfaces so they are free of foreign matter.

1. Remove grout residue from stone tile as soon as possible.
2. Clean grout smears and haze from stone tile in accordance with stone tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by stone tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of stone tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.6 PROTECTION

A. Protect installed stone tile floors with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by stone tile manufacturer, apply coat of neutral protective cleaner to completed stone tile walls and floors.

B. Prohibit foot and wheel traffic from stone tiled floors for at least seven days after grouting is completed.

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C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from stone tile surfaces.

3.7 EXTERIOR STONE TILE INSTALLATION SCHEDULE

A. Exterior Floor Installations:

1. TCNA F101 STONE <Insert designation>: Method [ANSI A108.1A][ANSI A108.1B][ANSI A108.1C]. Cement mortar bed (thickset) [bonded to concrete][over waterproof membrane on concrete][over waterproof membrane on concrete where indicated and bonded to concrete where membrane is not indicated].

    a. Stone Tile Type: <Insert stone-tile-type designation>.
    b. Bond Coat for Cured-Bed Method: [Dry-set][Modified dry-set][Improved modified dry-set] mortar.

        1) Color: White.

    c. Grout: [Sand-portland cement][Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement] grout.

        1) Color: White.

    d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
    e. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
    f. Movement Joints: Types located on Drawings.

2. TCNA F102 STONE <Insert designation>: Thinset mortar [on concrete][over waterproof membrane on concrete][over waterproof membrane on concrete where indicated and on concrete where membrane is not indicated][over crack isolation membrane on concrete][over crack isolation membrane on concrete where indicated and on concrete where membrane is not indicated].

    a. Stone Tile Type: <Insert stone-tile-type designation>.
    b. Thinset Mortar: [Dry-set][Modified dry-set][Improved modified dry-set] mortar.

        1) Color: White.

    c. Grout: [Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement] grout.
    d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
    e. Crack Isolation Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-

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reinforced, fluid-applied membrane].
f. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
g. Movement Joints: Types located on Drawings.

B. Exterior Roof/Deck Floor Installations:

1. TCNA F103 STONE <Insert designation>: Method [ANSI A108.1A][ANSI A108.1B][ANSI A108.1C]. Cement mortar bed (thickset) [over waterproof membrane on concrete][over waterproof membrane on concrete where indicated and on concrete where membrane is not indicated] over drainage material on roof membrane.

a. Stone Tile Type: <Insert stone-tile-type designation>.
b. Bond Coat for Cured-Bed Method: [Modified dry-set][Improved modified dry-set] mortar.

1) Color: White.

c. Grout: [Sand-portland cement][Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement] grout.
d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
e. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
f. Movement Joints: Types located on Drawings.

2. TCNA F104 STONE <Insert designation>: Thinset mortar [on concrete][over waterproof membrane on concrete][over waterproof membrane on concrete where indicated and on concrete where membrane is not indicated][over crack isolation membrane on concrete][over crack isolation membrane on concrete where indicated and on concrete where membrane is not indicated].

a. Stone Tile Type: <Insert stone-tile-type designation>.
b. Thinset Mortar: [Modified dry-set][Improved modified dry-set] mortar.

1) Color: White.

c. Grout: [Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement] grout.
d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
e. Crack Isolation Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
f. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
g. Movement Joints: Types located on Drawings.

C. Exterior Wall Installations, Masonry or Concrete:

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1. TCNA W201 STONE <Insert designation>: Method [ANSI A108.1A][ANSI A108.1B][ANSI A108.1C]. Cement mortar bed (thickset) on metal lath [over waterproof membrane][over water-resistant barrier][over vapor-retarder membrane].

    a. Stone Tile Type: <Insert stone-tile-type designation>.
    b. Bond Coat for Cured-Bed Method: [Dry-set][Modified dry-set][Improved modified dry-set] mortar.

        1) Color: White.

    c. Grout: [Sand-portland cement][Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement] grout.
    d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
    e. Water-Resistive Barrier: Compliant with local code requirements [and][specified in Division 07].
    f. Vapor Retarder: Compliant with local code requirements [and][specified in Division 07].
    g. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
    h. Movement Joints: Types located on Drawings.

2. TCNA W202E STONE <Insert designation>: Thinset mortar [over waterproof membrane][over water-resistive barrier][over vapor retarder membrane].

    a. Stone Tile Type: <Insert stone-tile-type designation>.
    b. Thinset Mortar: [Dry-set][Modified dry-set][Improved modified dry-set] mortar.

        1) Color: White.

    c. Grout: [Sand-portland cement][Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement] grout.
    d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
    e. Water-Resistive Barrier: Compliant with local code requirements [and][specified in Division 07].
    f. Vapor Retarder: Compliant with local code requirements [and][specified in Division 07].
    g. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
    h. Movement Joints: Types located on Drawings.

D. Exterior Wall Installations, Wood or Metal Studs:

1. TCNA W244E STONE <Insert designation>: Thinset mortar [over waterproof membrane on cementitious backer units][on cementitious backer units over vapor-retarder membrane][on cementitious backer units over water-resistive

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barrier].

a. Stone Tile Type: <Insert stone-tile-type designation>.
b. Thinset Mortar: [Dry-set][Modified dry-set][Improved modified dry-set] mortar.

1) Color: White.

c. Grout: [Standard sanded cement][Standard unsanded cement][High-performance sanded][High-performance unsanded] grout.
d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
e. Water-Resistive Barrier: Compliant with local code requirements [and][specified in Division 07].
f. Vapor Retarder: Compliant with local code requirements [and][specified in Division 07].
g. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
h. Movement Joints: Types located on Drawings.

3.8 INTERIOR STONE TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. TCNA F111 STONE <Insert designation>: Method [ANSI A108.1A][ANSI A108.1B][ANSI A108.1C]. Cement mortar bed (thickset) with cleavage membrane.

a. Stone Tile Type: <Insert stone-tile-type designation>.
b. Bond Coat for Cured-Bed Method: [Dry-set][Modified dry-set mortar][Improved modified dry-set mortar][Water-cleanable, tile-setting epoxy].

1) Color: White.

c. Grout: [Sand-portland cement][Standard sanded cement][Standard unsanded cement][High-performance sanded][High-performance unsanded] grout.
d. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
e. Movement Joints: Types located on Drawings.

2. TCNA F125-Full STONE <Insert designation>: Thinset mortar on crack isolation membrane.

a. Stone Tile Type: <Insert stone-tile-type designation>.
b. Thinset Mortar: [Modified dry-set][Improved modified dry-set] mortar.

1) Color: White.

c. Grout: [Standard sanded cement][Standard unsanded cement][High-

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performance sanded][High-performance unsanded][Water-cleanable epoxy] grout.
d. Crack Isolation Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Asphaltic sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
e. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
f. Movement Joints: Types located on Drawings.

B. Interior Floor Installations, Wood Subfloor:

1. TCNA F141 STONE <Insert designation>: Method [ANSI A108.1A][ANSI A108.1B][ANSI A108.1C]. Cement mortar bed (thickset) over cleavage membrane [over waterproof membrane].

a. Stone Tile Type: <Insert stone-tile-type designation>.
b. Bond Coat for Cured-Bed Method: [Dry-set][Modified dry-set mortar][Improved modified dry-set mortar][Water-cleanable, tile-setting epoxy].

1) Color: White.

c. Grout: [Sand-portland cement][Standard sanded cement][Standard unsanded cement][High-performance sanded][High-performance unsanded][Water-cleanable epoxy] grout.
d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
e. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
f. Movement Joints: Types located on Drawings.

C. Interior Wall Installations, Masonry or Concrete:

1. TCNA W202I STONE <Insert designation>: Thinset mortar [over waterproof membrane].

a. Stone Tile Type: <Insert tile-type designation>.
b. Thinset Mortar: [Dry-set][Modified dry-set][Improved modified dry-set][Water-cleanable epoxy] mortar.

1) Color: White.

c. Grout: [Standard sanded cement][Standard unsanded cement][High-performance sanded cement][High-performance unsanded cement][Water-cleanable epoxy] grout.
d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
e. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
f. Movement Joints: Types located on Drawings.

2. TCNA W211 STONE <Insert designation>: Method [ANSI A108.1A][ANSI

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A108.1B][ANSI A108.1C]. Cement mortar bed (thickset) bonded to substrate [over waterproof membrane].

a. Stone Tile Type: <Insert stone-tile-type designation>.
b. Bond Coat for Cured-Bed Method: [Dry-set][Modified dry-set mortar][Improved modified dry-set mortar][Water-cleanable, tile-setting epoxy].

1) Color: White.

c. Grout: [Sand-portland cement][Standard sanded cement][Standard unsanded cement][High-performance sanded][High-performance unsanded][Water-cleanable epoxy] grout.
d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
e. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
f. Movement Joints: Types located on Drawings.

D. Interior Wall Installations, Wood or Metal Studs or Furring:

1. TCNA W243 STONE <Insert designation>: [Thinset mortar][Water-cleanable, tile-setting epoxy] on gypsum board.

a. Stone Tile Type: <Insert stone-tile-type designation>.
b. Thinset Mortar: [Dry-set][Modified dry-set][Improved modified dry-set] mortar.

1) Color: White.

c. Grout: [Sand-portland cement][Standard sanded cement][Standard unsanded cement][High-performance sanded][High-performance unsanded][Water-cleanable epoxy] grout.
d. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
e. Movement Joints: Types located on Drawings.

2. TCNA W245 STONE <Insert designation>: [Thinset mortar][Water-cleanable, tile-setting epoxy] on glass-mat, water-resistant gypsum backer board [over waterproof membrane].

a. Stone Tile Type: <Insert stone-tile-type designation>.
b. Thinset Mortar: [Dry-set][Modified dry-set][Improved modified dry-set] mortar.

1) Color: White.

c. Grout: [Sand-portland cement][Standard sanded cement][Standard unsanded cement][High-performance sanded][High-performance unsanded][Water-cleanable epoxy] grout.
d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-

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reinforced, fluid-applied membrane].
e. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
f. Movement Joints: Types located on Drawings.

E. Bathtub Wall Installations with No Shower Head, Wood or Metal Studs, or Furring:

1. TCNA B413 STONE <Insert designation>: [Thinset mortar][Water-cleanable, tile-setting epoxy] on [water-resistant gypsum board][coated glass-mat, water-resistant gypsum board].

a. Stone Tile Type: <Insert stone-tile-type designation>.
b. Thinset Mortar: [Standard dry-set][Modified dry-set][Improved modified dry-set] mortar.

1) Color: White.

c. Grout: [Sand-portland cement][Standard sanded cement][Standard unsanded cement][High-performance sanded][High-performance unsanded][Water-cleanable epoxy] grout.
d. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
e. Movement Joints: Types located on Drawings.

F. Bathtub/Shower Wall Installations:

1. TCNA B419 STONE <Insert designation>: [Thinset mortar][Water-cleanable, tile-setting epoxy][over waterproof membrane] on coated glass-mat, water-resistant gypsum backer board.

a. Stone Tile Type: <Insert stone-tile-type designation>.
b. Thinset Mortar: [Modified dry-set][Improved modified dry-set] mortar.

1) Color: White.

c. Grout: [Standard sanded cement][Standard unsanded cement][High-performance sanded][High-performance unsanded][Water-cleanable epoxy] grout.
d. Waterproof Membrane: [As recommended by setting material manufacturer][Polyethylene sheet][Fluid-applied membrane][Fabric-reinforced, fluid-applied membrane].
e. Joint Width: [1/8 inch][3/16 inch][1/4 inch][3/8 inch]<Insert width>.
f. Movement Joints: Types located on Drawings.

END OF SECTION 093033

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SECTION 095123 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Acoustical tiles.
2. Metal suspension system.
3. Metal edge moldings and trim.

B. Related Requirements:

1. Section 095113 "Acoustical Panel Ceilings" for ceilings consisting of mineral-base and glass-fiber-base acoustical panels and exposed suspension systems.
2. Section 095133 "Acoustical Metal Pan Ceilings" for ceilings consisting of metal-pan units with exposed and concealed suspension systems.

C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]<Insert location>.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

C. Samples for Initial Selection: For components with factory-applied finishes.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Tiles: Set of full-size Samples of each type, color, pattern, and texture.
2. Concealed Suspension-System Members: [6-inch-]<Insert dimension> long Sample of each type.
3. Exposed Moldings and Trim: Set of [6-inch-]<Insert dimension> long Samples of each type and color.
4. Seismic Clips: Full size.

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E. Delegated Design Submittals: For seismic restraints for ceiling systems.

1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.

    a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.

4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical tile.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:

    a. Lighting fixtures.
    b. Diffusers.
    c. Grilles.
    d. Speakers.
    e. Sprinklers.
    f. Access panels.
    g. Perimeter moldings.
    h. <Insert item>.

7. Show operation of hinged and sliding components adjacent to acoustical tiles.
8. Minimum Drawing Scale: [1/4 inch = 1 foot][1/8 inch = 1 foot][1:50][1:100]<Insert scale>.

B. Qualification Data: For testing agency.

C. Product Test Reports: For each acoustical tile ceiling, for tests performed by [manufacturer and witnessed by a qualified testing agency][a qualified testing agency].

D. Evaluation Reports: For each acoustical tile ceiling suspension system [and anchor and fastener type], from ICC-ES.

E. Field quality-control reports.

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1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials [, from the same production run,] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size tiles equal to [2]<Insert number> percent of quantity installed.
2. Suspension-System Components: Quantity of each concealed grid and exposed component equal to [2]<Insert number> percent of quantity installed.

1.7 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical ceiling area as indicated 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.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical tiles, suspension-system components, and accessories to Project site 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 tiles, permit them to reach room temperature and a stabilized moisture content.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and weathertight, 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 tile ceiling installation.

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PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations for Suspended Acoustical Tile Ceiling System: Obtain each type of acoustical ceiling tile and its suspension system from single source from single manufacturer.

B. Source Limitations for Directly Attached Acoustical Tile Ceiling Tile: Obtain each type of acoustical ceiling tile from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraints for ceiling systems.

B. Seismic Performance: Suspended ceilings to withstand the effects of earthquake motions determined in accordance with [ASCE/SEI 7]<Insert requirement>.

C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class [A][B][C] in accordance with ASTM E1264.
2. Smoke-Developed Index: [50][450]<Insert value> or less.

D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL or from the listings of another qualified testing agency.

2.3 ACOUSTICAL TILES

A. Acoustical Tiles:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. Armstrong World Industries
    b. CertainTeed; SAINT-GOBAIN
    c. USG Corporation

2. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E1264 classifications as designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
3. Recycled Content: Postconsumer recycled content plus one-half of preconsumer

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recycled content not less than <Insert number> percent.

4. Classification: Provide [fire-resistance-rated] tiles as follows:

    a. Type and Form, Type III: Mineral base with painted finish; Form 1, nodular.
    b. Type and Form: <Insert type and form>.
    c. Pattern: CD (perforated, small holes and fissured).

5. Color: As selected from manufacturer's full range.
6. Light Reflectance (LR): Not less than LR indicated in a schedule.
7. Ceiling Attenuation Class (CAC): Not less than CAC indicated in a schedule.
8. Noise Reduction Coefficient (NRC): Not less than NRC indicated in a schedule.
9. Articulation Class (AC): Not less than AC indicated in a schedule.
10. Edge/Joint Detail: As indicated by manufacturer's designation.
11. Thickness: As indicated on Drawings.
12. Modular Size: As indicated on Drawings.
13. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested in accordance with ASTM D3273, ASTM D3274, or ASTM G21 and evaluated in accordance with ASTM D3274 or ASTM G21.

2.4 METAL SUSPENSION SYSTEM

A. Concealed or Semi-Exposed Metal Suspension System:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. Armstrong World Industries
    b. CertainTeed; SAINT-GOBAIN
    c. USG Corporation

2. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, fully concealed, metal suspension system and accessories of type, structural classification, and finish indicated that complies with applicable requirements in ASTM C635/C635M.

    a. High-Humidity Finish: Where indicated, provide coating tested and classified for "severe environment performance" in accordance with ASTM C635/C635M.

3. Direct-Hung, Double-Web Suspension System: Main and cross runners roll formed from and capped with cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation.

    a. Fire Rating: [As indicated on Drawings]<Insert fire rating>.
    b. Structural Classification: Intermediate -duty system.
    c. Access: Upward and [end pivoted][or][side pivoted], with initial access

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openings of size indicated below and located throughout ceiling within each module formed by main and cross runners, with additional access available by progressively removing remaining acoustical tiles.

1) Initial Access Opening: In each module, As indicated on Drawings.

2.5 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

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]<Insert safety factor> times that imposed by ceiling construction, as determined by testing in accordance with ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.

    a. Type: [Cast-in-place][Postinstalled expansion][Postinstalled bonded] anchors.
    b. Corrosion Protection, Carbon Steel: Components zinc plated in accordance with ASTM B633, Class SC 1 (mild) service condition.
    c. Corrosion Protection, Stainless Steel: Components complying with ASTM F593 and ASTM F594, Group 1 Alloy 304 or 316.

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]<Insert safety factor> times that imposed by ceiling construction, as determined by testing in accordance with ASTM E1190, conducted by a qualified testing and inspecting agency.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
2. Stainless Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
3. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than [0.106-inch-][0.135-inch-]<Insert dimension> diameter wire.

C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 coating

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designation; with bolted connections and 5/16-inch- diameter bolts.

F. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate lateral forces.

H. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical tiles in-place during a seismic event.

2.6 METAL EDGE MOLDINGS AND TRIM

A. Metal Edge Moldings and Trim:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. CertainTeed; SAINT-GOBAIN
    b. USG Corporation

2. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations complying with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for of suspension-system runners.

    a. Edge moldings to fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
    b. 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]<Insert description>.
    c. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
    d. Finish: Painted in color as selected from manufacturer's full range.

3. 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.

    a. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
    b. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils. Comply with ASTM C635/C635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

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2.7 ACOUSTICAL SEALANT

A. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

2.8 MISCELLANEOUS MATERIALS

A. Acoustical Tile Adhesive: Type recommended in writing by acoustical tile manufacturer, bearing UL label for Class 0-25 flame spread.

B. Staples: 5/16-inch- long, divergent-point staples.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine acoustical tiles before installation. Reject acoustical tiles that are wet, moisture damaged, or mold damaged.

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

3.2 PREPARATION

A. Testing Substrates: Before adhesively bonding tiles to wet-placed substrates such as cast-in-place concrete or plaster, test and verify that moisture level is below tile manufacturer's recommended limits.

B. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

C. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS

A. Install suspended acoustical tile ceilings in accordance with ASTM C636/C636M [, seismic design requirements,] and manufacturer's written instructions.

1. Fire-Rated Assembly: Install fire-rated ceiling systems in accordance with tested fire-rated design.

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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 [and, if permitted with fire-resistance-rated ceilings,] to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. 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.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure 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.
5. 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 the structure to which hangers are attached and the 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.
6. 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.
7. 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.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. 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.
11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

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 tiles.

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. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

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E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Arrange directionally patterned acoustical tiles as follows:

1. As indicated on reflected ceiling plans.
2. Install tiles with pattern running in one direction parallel to [long][short] axis of space.
3. Install tiles in a basket-weave pattern.

G. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension-system flanges into kerfed edges of tiles so tile-to-tile joints are interlocked.

1. Fit adjoining tiles to form flush, tight joints. Scribe and cut tiles for accurate fit at borders and around penetrations through ceiling.
2. Hold tile field in compression by inserting leaf-type, spring-steel spacers between tiles and moldings, spaced 12 inches o.c.
3. Protect lighting fixtures and air ducts in accordance with requirements indicated for fire-resistance-rated assembly.

3.4 INSTALLATION OF DIRECTLY ATTACHED ACOUSTICAL TILE CEILINGS

A. Adhesive Installation: Install acoustical tile by bonding to substrate, using acoustical tile adhesive and procedure recommended in writing by tile manufacturer and as follows:

1. Wipe and prime ceiling.
2. Remove loose dust from backs of tiles by brushing.
3. Install splines in joints between tiles and maintain bottom surface to a uniform level. Shim tile or correct substrate as required to maintain levelness.
4. Maintain tight butt joints, aligned in both directions and coordinated with ceiling fixtures.

B. Stapled Installation: Fasten acoustical tile to substrate using a minimum of two staples per tile that are installed in flanges of tile and as follows:

1. Form double-lapped joint between tiles by securely pressing tile tongues into corresponding tile grooves.
2. Maintain bottom surface of tiles to a uniform level. Shim tile or correct substrate as required to maintain levelness.
3. Maintain tight butt joints, aligned in both directions and coordinated with ceiling fixtures.

C. Install edge moldings and trim of type indicated at perimeter of acoustical tile ceiling area and where necessary to conceal edges of acoustical units.

D. Arrange directionally patterned acoustical tiles [as indicated on Drawings][with pattern running in one direction parallel to long axis of space][with pattern running in one direction parallel to short axis of space][in a basket-weave pattern]<Insert requirement>.

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3.5 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of [1/8 inch in 12 feet]<Insert dimensions>, non-cumulative.

B. Directly Attached Ceilings: Install bottom surface of tiles to a tolerance of [1/8 inch in 12 feet and not exceeding 1/4 inch cumulatively]<Insert requirement>.

C. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of [1/8 inch in 12 feet]<Insert dimensions>, non-cumulative.

3.6 FIELD QUALITY CONTROL

A. Special Inspections: [Owner will engage][Engage] a qualified special inspector to perform the following special inspections:

1. Periodic inspection during the installation of suspended ceiling grids in accordance with ASCE/SEI 7.

B. Testing Agency: [Owner will engage][Engage] a qualified testing agency to perform tests and inspections.

C. Perform the following tests and inspections of completed installations of acoustical tile ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no tiles have been installed. Do not proceed with installations of acoustical tile ceiling hangers for the next area until test results for previously completed installations of acoustical tile ceiling hangers show compliance with requirements.

1. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf of tension.
2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

D. Acoustical tile ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.7 ADJUSTING

A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

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B. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

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SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vinyl base.
2. Rubber stair accessories.
3. Rubber molding accessories.
4. Vinyl molding accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party Certified Life Cycle Assessment: For each product.

C. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.

D. Samples for Initial Selection: For each type of product indicated.

E. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.

F. Product Schedule: For resilient base and accessory products. [Use same designations indicated on Drawings.]

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials [, from the same product run,] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than [10 linear feet]<Insert dimension> for every [500 linear feet]<Insert dimension> or fraction thereof, of each type, color, pattern, and size of resilient product installed.

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1.4 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Coordinate mockups in this Section with mockups specified in other Sections.
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.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than [70 deg F]<Insert temperature> or more than [95 deg F]<Insert temperature>, in spaces to receive resilient products during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than [55 deg F]<Insert temperature> or more than [95 deg F]<Insert temperature>.

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

PART 2 - PRODUCTS

2.1 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

C. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-

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tread manufacturer to fill nosing substrates that do not conform to tread contours.

D. Metal Edge Strips: [Extruded aluminum with mill finish]<Insert requirements>, nominal 2 inches wide, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

E. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum 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.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than [9][10]<Insert number> pH.
4. Moisture Testing: Perform tests so that each test area does not exceed [200 sq. ft.][1000 sq. ft.]<Insert area>, and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [3 lb

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of water/1000 sq. ft.]<Insert rate> in 24 hours.

b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum [75]<Insert number> percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than [3 inches]<Insert dimension> in length.

a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than [3 inches]<Insert dimension> in length.

a. [Miter][Cope][Miter or cope] corners to minimize open joints.

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3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Stair Accessories:

1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
2. Tightly adhere to substrates throughout length of each piece.
3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum horizontal surfaces thoroughly.
3. Damp-mop horizontal surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, adhesive, and blemishes from resilient stair treads before applying liquid floor polish.

1. Apply [one][two][three]<Insert requirement> coat(s).

E. Cover resilient products subject to wear and foot traffic until Substantial Completion.

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SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rubber floor tile.
2. Vinyl composition floor tile.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party Certified Life Cycle Assessment: For each product.

C. Shop Drawings: For each type of resilient floor tile.

1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
2. Show details of special patterns.

D. Samples: Full-size units of each color, texture, and pattern of floor tile required.

1. For heat-welding bead, manufacturer's standard-size Samples, but not less than [9 inches]<Insert dimension> long, of each color required.

E. Samples for Initial Selection: For each type of floor tile indicated.

F. Samples for Verification: Full-size units of each color and pattern of floor tile required.

1. For heat-welding bead, manufacturer's standard-size Samples, but not less than [9 inches]<Insert dimension> long, of each color required.

G. Welded-Seam Samples: For seamless-installation technique indicated and for each floor covering product, color, and pattern required; with seam running lengthwise and in center of [6-by-9-inch]<Insert dimensions> Sample applied to a rigid backing and prepared by Installer for this Project.

H. Product Schedule: For floor tile. [Use same designations indicated on Drawings.]

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1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials [, from the same product run,] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box for every [50]<Insert number> boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Coordinate mockups in this Section with mockups specified in other Sections.

a. Size: Minimum 100 sq. ft. for each type, color, and pattern [in locations indicated][in locations directed by Architect]<Insert locations>.

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 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

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1.8 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than [70 deg F]<Insert temperature> or more than [95 deg F]<Insert temperature>, in spaces to receive floor tile during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than [55 deg F]<Insert temperature> or more than [95 deg F]<Insert temperature>.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

C. Seamless-Installation Accessories:

1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.

a. Colors: As selected by Architect from manufacturer's full range to contrast with floor tile.

2. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.

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D. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

E. Joint Sealant for Resilient Terrazzo Floor Tile: Silicone sealant of type and grade recommended in writing by floor tile manufacturer to suit resilient terrazzo floor tile.

1. Joint-Sealant Color: [White][As selected by Architect from manufacturer's full range to match floor tile][Match floor tile]<Insert color>.

F. Sealers and Finish Coats for Resilient Terrazzo Floor Tile: Products recommended by floor tile manufacturer for resilient terrazzo floor tile.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum 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 floor tile.

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

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than [9][10]<Insert number> pH.
4. Moisture Testing: Perform tests so that each test area does not exceed [200 sq. ft.][1000 sq. ft.]<Insert area>, and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [3 lb

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of water/1000 sq. ft.]<Insert rate> in 24 hours.

b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum [75]<Insert number> percent relative humidity level measurement.

C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.

D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

E. Do not install floor tiles until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

F. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor 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][at a 45-degree angle with room axis][in pattern indicated]<Insert requirements>.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles [with grain running in one direction][with grain direction alternating in adjacent tiles (basket-weave pattern)][in pattern of colors and sizes indicated].

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and

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pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Seamless Installation:

1. Heat-Welded Seams: Comply with ASTM F1516. Rout joints and heat weld with welding bead to fuse sections permanently into a seamless flooring installation. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.
2. Chemically Bonded Seams: Bond seams with chemical-bonding compound to fuse sections permanently into a seamless flooring installation. Prepare seams and apply compound to produce tightly fitted seams without gaps, overlays, or excess bonding compound on flooring surfaces.

J. Resilient Terrazzo Accessories: Install according to manufacturer's written instructions.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.

1. Apply [one][two][three]<Insert requirements> coat(s).

E. Joint Sealant: Apply sealant to resilient terrazzo floor tile perimeter and around columns, at door frames, and at other joints and penetrations.

F. Sealers and Finish Coats: Remove soil, visible adhesive, and surface blemishes from resilient terrazzo floor tile surfaces before applying liquid cleaners, sealers, and finish products.

1. Sealer: Apply two base coats of liquid sealer.
2. Finish: Apply [two][three]<Insert requirements> coats of liquid floor finish.

G. Cover floor tile until Substantial Completion.

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END OF SECTION 096519

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SECTION 096723 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resinous flooring.
2. Integral cove base accessories.

B. Related Sections:

1. Section 071800 "Traffic Coatings" for vehicular-traffic-bearing, elastomeric flooring systems.
2. Section 096623 "Resinous Matrix Terrazzo Flooring" for thinset, epoxy-matrix terrazzo.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review manufacturer's written instructions for substrate preparation and environmental conditions affecting resinous flooring installation.
2. Review details of integral cove bases.
3. Review manufacturer's written instructions for installing resinous flooring systems.
4. Review protection measures for adjacent construction and installed flooring, floor drainage requirements, curbs, base details, and so forth.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's technical data, installation instructions, and recommendations for each resinous flooring component required.

B. Samples: For each resinous floor system required and for each color and texture specified, 6 inches square in size, applied to a rigid backing by Installer for this Project.

C. Samples for Initial Selection: For each type of exposed finish required.

D. Samples for Verification: For each resinous flooring system required and for each color and texture specified, 6 inches square, applied to a rigid backing by Installer for this Project.

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1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Material Certificates: For each resinous flooring component.

C. Material Test Reports: For each resinous flooring system, by a qualified testing agency.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.6 QUALITY ASSURANCE

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

1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

1.7 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 storage and mixing with other components.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring installation.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring installation.

C. Close spaces to traffic during resinous flooring installation and for 24 hours after installation unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

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2.2 RESINOUS FLOORING

A. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

B. System Characteristics:

1. Color and Pattern: As selected by Architect from manufacturer's full range.
2. Wearing Surface: Textured for slip resistance.
3. Overall System Thickness: 1/8 inch.

C. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested in accordance with test methods indicated:

1. Compressive Strength: 6,000 minimum in accordance with ASTM C579.
2. Tensile Strength: 1,500 minimum in accordance with ASTM C307.
3. Flexural Modulus of Elasticity: 0.5x10(6) minimum in accordance with ASTM C580.
4. Water Absorption: 1.0% percent maximum in accordance with ASTM C413.
5. Shrinkage: <Insert number> percent maximum in accordance with ASTM C531.
6. Indentation: 7% percent maximum in accordance with MIL-D-3134J.
7. Impact Resistance: No chipping, cracking, or delamination and not more than 1/16-inch permanent indentation in accordance with MIL-D-3134J.
8. Resistance to Elevated Temperature: No slip or flow of more than 1/16 inch in accordance with MIL-D-3134J.
9. Critical Radiant Flux: 0.22 W/sq. cm or greater in accordance with NFPA 253.

D. System Chemical Resistance: Test specimens of cured resinous flooring system are unaffected when tested in accordance with ASTM D543, Procedure A, for immersion in the following reagents for no fewer than seven days:

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum 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 resinous flooring systems.

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

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3.2 PREPARATION

A. Prepare and clean substrates in accordance with resinous flooring manufacturer's written instructions for substrate indicated to ensure adhesion.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Roughen concrete substrates as follows:

    a. Comply with requirements in SSPC-SP 13/NACE No. 6, with a Concrete Surface Profile of 3 or greater in accordance with ICRI Technical Guideline No. 310.2R, unless manufacturer's written instructions are more stringent.

2. Repair damaged and deteriorated concrete in accordance with resinous flooring manufacturer's written instructions.
3. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

4. Alkalinity and Adhesion Testing: Perform tests recommended in writing by resinous flooring manufacturer. Proceed with installation only after substrate alkalinity is not less than 6 or more than 8 pH unless otherwise recommended in writing by flooring manufacturer,

C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates in accordance with manufacturer's written instructions.

1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring in accordance with manufacturer's written instructions.

D. Resinous Materials: Mix components and prepare materials in accordance with resinous flooring manufacturer's written instructions.

3.3 INSTALLATION

A. Apply components of resinous flooring system in accordance with manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness specified.

1. Coordinate installation of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
2. Cure resinous flooring components in accordance with manufacturer's written instructions. Prevent contamination during installation and curing processes.

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3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.

B. Integral Cove Base Accessories: Adhesively install precast accessories before applying flooring coats and in accordance with manufacturer's written instructions.

C. Field-Formed Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring coats. Apply in accordance with manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.

1. Integral Cove Base: 4 inches high.

D. Self-Leveling Body Coats: Apply self-leveling slurry body coats in thickness specified for flooring system.

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

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

3.4 FIELD QUALITY CONTROL

A. Material Sampling: Owner may, at any time and any number of times during resinous flooring installation, require material samples for testing for compliance with requirements.

1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reinstall flooring materials to comply with requirements.

B. Core Sampling: At Owner's direction and at locations designated by Owner, take one core sample per 1000 sq. ft. of resinous flooring, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Repair damage caused by coring. Correct deficiencies in installed flooring as indicated by testing.

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3.5 PROTECTION

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

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SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Carpet tile.

B. Related Requirements:

1. Section 024119 "Selective Demolition" for removing existing floor coverings.
2. [Section 096513 "Resilient Base and Accessories"][Section 096519 "Resilient Tile Flooring"] for resilient wall base and accessories installed with carpet tile.
3. Section 096816 "Sheet Carpeting" for carpet roll goods.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]<Insert location>.

1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:

a. Review delivery, storage, and handling procedures.
b. Review ambient conditions and ventilation procedures.
c. Review subfloor preparation procedures.
d. <Insert agenda items>.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation recommendations for each type of substrate.

B. Shop Drawings: For carpet tile installation, showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.

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6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of carpet tile.

1. Include Samples of exposed edge, transition, and other accessory stripping involving color or finish selection.

D. Samples for Verification: Actual sample of finished products for each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- long Samples.

E. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

F. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party Certified Life Cycle Assessment: For each product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

B. Qualification Statements: For Installer.

C. Sample Warranties: For carpet tile.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner

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that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is certified by the International Certified Floorcovering Installers Association at the [Commercial II][Master II]<Insert description> certification level.

1.8 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups [as indicated on Drawings]<Insert mockup requirements>.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104.

1.10 FIELD CONDITIONS

A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended in writing by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.11 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

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1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, the following:

    a. More than 10 percent loss of face fiber, edge raveling, snags, and runs.
    b. Loss of tuft-bind strength.
    c. Excess static discharge.
    d. Delamination.
    e. Dimensional instability.

3. Warranty Period: [10][15]<Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended in writing by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive types to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and that are recommended in writing by carpet tile manufacturer for releasable installation.

C. Metal Edge/Transition Strips: Extruded aluminum with [mill]<Insert finish> finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.

B. Examine carpet tile for type, color, pattern, and potential defects.

C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

1. Moisture Testing: Perform tests so that each test area does not exceed [200 sq. ft.][1000 sq. ft.]<Insert area>, and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

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a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [3 lb of water/1000 sq. ft.]<Insert emission> in 24 hours.
b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum [75]<Insert number> percent relative humidity level measurement.
c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

D. Wood Subfloors: Verify the following:

1. Underlayment over subfloor complies with requirements specified in Section 061600 "Sheathing."
2. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

E. Metal Subfloors: Verify the following:

1. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

F. Painted Subfloors: Perform bond test recommended in writing by adhesive manufacturer. Verify the following:

1. Underlayment surface is flat, smooth, evenly planed, tightly jointed, and free of irregularities, gaps greater than [1/8 inch]<Insert dimension>, protrusions more than 1/32 inch, and substances that may interfere with adhesive bond or show through surface.

G. Access Flooring Systems: Verify the following:

1. Access floor substrate is compatible with carpet tile and adhesive if any.

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

3.2 PREPARATION

A. General: Comply with CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates.

B. Use trowelable leveling and patching compounds, in accordance with manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by

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adhesive and carpet tile manufacturers.

D. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: [As recommended in writing by carpet tile manufacturer][Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive][Partial glue down; install periodic tiles with releasable, pressure-sensitive adhesive][Free lay; install carpet tiles without adhesive].

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns [indicated on Drawings][recommended in writing by carpet tile manufacturer].

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended in writing by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

I. Access Flooring: Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive and other surface blemishes using cleaner recommended in writing by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.

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3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI 104, Section 13.7.

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

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SECTION 097200 - WALL COVERINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Textile wall covering.

B. Owner-Furnished Materials: <Insert requirements>.

C. Related Requirements:

1. Section 092900 "Gypsum Board" for joint treatment materials for interior gypsum board and finish levels.
2. Section 099123 "Interior Painting" for preparation of surfaces receiving wall covering.
3. Section 099124 "Interior Painting (MPI Standards)" for preparation of surfaces receiving wall covering.
4. Section 101146 "Visual Display Fabrics" for dry-erase wall coverings.
5. Section 102600 "Wall and Door Protection" for abuse-resistant wallcoverings.

1.2 ALLOWANCES

A. See Section 012100 "Allowances" for description of allowances affecting items specified in this Section.

1.3 UNIT PRICES

A. See Section 012200 "Unit Prices" for description of unit prices affecting items specified in this Section.

1.4 ALTERNATES

A. See Section 012300 "Alternates" for description of alternates affecting items specified in this Section.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference [at Project site][by web conference]<Insert location>.

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1.6 ACTION SUBMITTALS

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

1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.

B. Shop Drawings:

1. Show location and extent of each wall-covering type.
2. Indicate [pattern placement][veneer matching] seams and termination points.

C. Samples: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by [36 inches]<Insert dimension> long in size.

1. Wall-Covering Sample: From same production run to be used for the Work, with specified [treatments][paint] applied.

a. Show complete pattern repeat.
b. Mark top and face of fabric.

2. Wood-Veneer Wall-Covering Sample: From same flitch to be used for the Work, with specified finish applied.

D. Samples for Initial Selection: For each type of wall covering.

E. Samples for Verification: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by [36 inches]<Insert dimension> long in size.

1. Wall-Covering Sample: From same production run to be used for the Work, with specified [treatments][paint] applied.

a. Show complete pattern repeat.
b. Mark top and face of fabric.

2. Wood-Veneer Wall-Covering Sample: From same flitch to be used for the Work, with specified finish applied.

F. Product Schedule: For wall coverings. [Use same designations indicated on Drawings.]

1.7 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each wall covering, for tests performed by a qualified testing agency.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For wall coverings.

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1.9 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Wall-Covering Materials: For each type, color, texture, and finish, full width by length to equal to [5]<Insert number> percent of amount installed.

1.10 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for installation.

1. Build mockups for each type of wall covering on each substrate required. Comply with requirements in ASTM F1141 for appearance shading characteristics.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.

1. Wood-Veneer Wall Coverings: Condition spaces for not less than 48 hours before installation.

B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall covering.

C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer’s written instructions for full drying or curing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates in accordance with test method indicated below by a qualified testing agency. Identify products with appropriate markings of

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applicable testing agency.

1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: [25]<Insert value> or less.
    b. Smoke-Developed Index: [50][450]<Insert value> or less.

2. Fire-Growth Contribution: No flashover and heat and smoke release when tested in accordance with [NFPA 265][NFPA 286].

2.2 WALL COVERINGS

A. Textile Wall Covering:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. Designtex; Design Tex Group Inc. (The)
    b. Hytex Industries Inc.
    c. Innovations USA
    d. Knoll, Inc.

2. Description: Provide wall coverings in rolls from same production run and that comply with the following:

    a. ASTM F793/F793M: Category II, Decorative with Medium Serviceability.
    b. Wallcoverings Association's W: Type II, Medium Duty (Polyolefin Coated).

3. Test Responses:

    a. Colorfastness to Wet and Dry Crocking: [Complies with AATCC 8, Grade 3, minimum]<Insert requirements>.
    b. Colorfastness to Light: [Complies with AATCC 16.2 Test Option 1 or AATCC 16.3 Test Option 3, Class L4, minimum, at 40 hours]<Insert requirements>.
    c. Mildew Resistance: Rating of zero or 1 when tested in accordance with ASTM G21.

4. Total Weight: <Insert weight>, excluding coatings.
5. Width: <Insert width>.
6. Repeat: [Random]<Insert requirements>.
7. Applied Backing Material: Paper.
8. Features:

    a. Stain-Resistant Coating: <Insert requirements>.
    b. Tackable.

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c. [Peelable][Strippable].
d. Antimicrobial.
e. Water-based inks.
f. PVC free.
g. Phthalate free.
h. Heavy-metals free.
i. Halogenated-fire-retardant free.

9. Colors, Textures, and Patterns: As selected by Architect from manufacturer's full range.

2.3 ACCESSORIES

A. Adhesives: Mildew-resistant, nonstaining [, strippable] adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.

B. Primer/Sealer: Mildew resistant, complying with [requirements in Section 099123 "Interior Painting"]<Insert requirements> and recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.

C. Metal Primer: Interior ferrous metal primer complying with [requirements in Section 099123 "Interior Painting"]<Insert requirements> and recommended in writing by primer and wall-covering manufacturers for intended substrate.

D. Wall Liner: Nonwoven, synthetic underlayment and adhesive as recommended in writing by wall-covering manufacturer.

E. Seam Tape: As recommended in writing by wall-covering manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation surfaces being true in plane and vertical and horizontal alignment, maximum moisture content, and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, and mildew.

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C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.

1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
2. Plaster: Allow plaster to cure for at least 90 days. Neutralize areas of high alkalinity. Apply primer/sealer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
3. Metals: If not factory primed, clean and apply metal primer as recommended in writing by metal-primer manufacturer and wall-covering manufacturer.
4. Gypsum Board: Confirm required level of finish per manufacturers' written instructions. Apply primer/sealer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
5. Painted Surfaces:

    a. Check for pigment bleeding. Apply primer/sealer to areas susceptible to pigment bleeding as recommended in writing by primer/sealer manufacturer.
    b. Sand gloss, semigloss, and eggshell finishes with fine sandpaper.

D. Wall Liners: Provide wall liner only when necessary to correct substrate irregularities to achieve a uniform surface or where recommended by the wall covering manufacturer for warranty compliance.

E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

F. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.3 INSTALLATION OF WALL COVERINGS

A. Comply with wallcovering manufacturers' written installation instructions applicable to products and applications indicated.

B. Apply adhesive in compliance with manufacturers' written installation instructions

C. Cut wallcovering strips in roll number sequence. Change the roll numbers at partition breaks and corners.

D. Install strips in same order as cut from roll.

1. For solid-color, even-texture, or random-match wall coverings, reverse every other strip.

E. Install wall covering without lifted or curling edges and without visible shrinkage.

F. Match pattern [72 inches]<Insert dimension> above the finish floor.

G. Install seams vertical and plumb at least 6 inches from outside corners and [3 inches][6

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inches] from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.

H. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.

I. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

J. Wood-Veneer Wall Coverings: Provide field finishing as follows:

1. Apply specified finish system in accordance with coating manufacturer's written instructions to produce finish that is consistent in color and gloss and matches approved Samples.
2. Apply no fewer than [two][three] finish coats.

3.4 CLEANING

A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.

B. Use cleaning methods recommended in writing by wall-covering manufacturer.

C. Replace strips that cannot be cleaned.

D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

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SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Surface preparation of exterior substrates and application of the following:

1. Primers.
2. Water-based finish coatings.
3. Solvent-based finish coatings.
4. Floor sealers and paints.

B. Related Requirements:

1. [Section 051200 "Structural Steel Framing"][Section 051213 "Architecturally Exposed Structural Steel Framing"] for shop priming structural steel substrates.
2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
3. Section 055113 "Metal Pan Stairs" for shop priming metal pan stairs.
4. Section 055116 "Metal Floor Plate Stairs" for shop priming metal floor plate stairs.
5. Section 055119 "Metal Grating Stairs" for shop priming metal grating stairs.
6. Section 055213 "Pipe and Tube Railings" for shop [priming][painting] pipe and tube railings.
7. [Section 055313 "Bar Gratings"][Section 055316 "Plank Gratings"][Section 055319 "Expanded Metal Gratings"] for shop priming metal gratings.
8. Section 099123 "Interior Painting."
9. Section 099300 "Staining and Transparent Finishing" for surface preparation and application of wood stains and transparent finishes on exterior wood substrates.
10. Section 099600 "High-Performance Coatings" for tile-like coatings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include preparation requirements and application instructions.
2. Indicate VOC content.

B. Samples: For each type of topcoat product.

C. Samples for Initial Selection: For each type of topcoat product.

D. Samples for Verification: For each type of paint system and each color and gloss of topcoat. Submit [actual paint drawdowns as specified below][paint manufacturer's standard printed cards] for verification Samples.

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1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

E. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in applicable exterior painting schedule articles to cross-reference paint systems specified in this Section. Include color designations.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match paint products applied and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint Products: [5]<Insert number> percent, but not less than [1 gal.]<Insert value> of each material and color applied.

1.4 MOCKUPS

A. Apply mockups of each paint system indicated and each color and finish selected to verify selections made under Sample submittals, demonstrate aesthetic effects, and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

    a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
    b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

    a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, 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.

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1.6 FIELD 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 in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each paint product from single source from single manufacturer.

2.2 EXTERIOR PAINTS, GENERAL

A. Exterior Paints: Subject to compliance with requirements, [provide product][provide one of the products][available products that may be incorporated into the Work include but are not limited to products] listed in product types below and applicable exterior painting schedule articles for the paint category indicated.

B. Material Compatibility:

1. Materials for use within each paint system must be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturer for use in paint system and on substrate indicated.

C. Colors: [As selected by Architect from manufacturer's full range][Match Architect's samples][As indicated in a color schedule on Drawings]<Insert requirements>.

1. [10][20][30]<Insert number> percent of surface area will be painted with deep tones.

2.3 PRIMERS

A. Exterior Wood Preservative: Solvent-based, zinc or copper napthenate, penetrating antifungal treatment for exterior wood.

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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 the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Cementitious Composition Board: 12 percent.
3. Masonry (Clay and CMU): 12 percent.
4. Wood: 15 percent.
5. Portland Cement Plaster (Stucco): 12 percent. Verify that plaster is fully cured.

C. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems specified in this Section.

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. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

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F. Steel Substrates: Remove loose rust, loose mill scale, loose shop primer, and other loose foreign matter. Clean using methods recommended in writing by paint manufacturer [.][but not less than the following:]

1. SSPC-SP 2.
2. SSPC-SP 3.
3. SSPC-SP 7/NACE No. 4.
4. SSPC-SP 11.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed substrates.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Aluminum Substrates: Remove loose surface oxidation.

J. Wood Substrates:

1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.
2. Sand surfaces that will be exposed to view and remove sanding dust.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

K. Canvas and Cotton Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

L. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION OF EXTERIOR PAINT PRODUCTS

A. Apply paints in accordance with manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint [both sides][exterior side] and edges of exterior doors and entire exposed surface of exterior door frames.
4. Paint entire exposed surface of window frames and sashes.
5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
6. Primers specified in applicable exterior painting schedule articles may be omitted on items that are factory primed or factory finished if compatible with intermediate

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and topcoat coatings and acceptable to intermediate and topcoat paint manufacturers.

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, Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed to view:

a. Equipment, including panelboards [and switch gear].
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Tanks that do not have factory-applied final finishes.
h. <Insert requirements>.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written instructions, apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written instructions.
3. Cost of retesting is Contractor's responsibility.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
2. Dispose of contaminants in accordance with requirements of authorities having

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jurisdiction.

3. Allow empty paint cans to dry before disposal.
4. Collect waste paint by type and deliver to recycling or collection facility.

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.

END OF SECTION 099113

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SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Surface preparation of interior substrates and application of the following:

1. Primers.
2. Water-based finish coatings.
3. Solvent-based finish coatings.
4. Floor sealers and paints.
5. Dry fall coatings.

B. Related Requirements:

1. [Section 051200 "Structural Steel Framing"][Section 051213 "Architecturally Exposed Structural Steel Framing"] for shop priming structural steel substrates.
2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
3. Section 055113 "Metal Pan Stairs" for shop priming metal pan stairs.
4. Section 055116 "Metal Floor Plate Stairs" for shop priming metal floor plate stairs.
5. Section 055119 "Metal Grating Stairs" for shop priming metal grating stairs.
6. Section 055213 "Pipe and Tube Railings" for shop [priming][painting] pipe and tube railings.
7. [Section 055313 "Bar Gratings"][Section 055316 "Plank Gratings"][Section 055319 "Expanded Metal Gratings"] for shop priming metal gratings.
8. Section 099113 "Exterior Painting."
9. Section 099300 "Staining and Transparent Finishing" for surface preparation and application of wood stains and transparent finishes on interior wood substrates.
10. Section 099600 "High-Performance Coatings" for tile-like coatings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include preparation requirements and application instructions.
2. Indicate VOC content.

B. Samples: For each type of topcoat product.

C. Samples for Initial Selection: For each type of topcoat product.

D. Samples for Verification: For each type of paint system and each color and gloss of topcoat. Submit [actual paint drawdowns as specified below][paint manufacturer's standard printed cards] for verification Samples.

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1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

E. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in applicable interior painting schedule articles to cross-reference paint systems specified in this Section. Include color designations.

F. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party-Certified Life-Cycle Assessment: For each product.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match paint products applied and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint Products: [5]<Insert number> percent, but not less than [1 gal.]<Insert value> of each material and color applied.

1.4 MOCKUPS

A. Apply mockups of each paint system indicated and each color and finish selected to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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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 FIELD 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 of less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each paint product from single source from single manufacturer.

2.2 INTERIOR PAINTS, GENERAL

A. Interior Paints: Subject to compliance with requirements, [provide product][provide one of the products][available products that may be incorporated into the Work include but are not limited to products] listed in product types below and applicable interior painting schedule articles for the paint category indicated.

B. Material Compatibility:

1. Materials for use within each paint system must be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturer for use in paint system and on substrate indicated.

C. Colors: [As selected by Architect from manufacturer's full range][Match Architect's samples][As indicated in a color schedule]<Insert requirements>.

1. [10][20][30]<Insert number> percent of surface area will be painted with deep tones.

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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 the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Cementitious Composition Board: 12 percent.
3. Masonry (Clay and CMU): 12 percent.
4. Wood: 15 percent.
5. Gypsum Board: 12 percent. Verify that finishing compound is dry and sanded smooth.
6. Plaster: 12 percent. Verify that plaster is fully cured.

C. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat 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. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if

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moisture content or alkalinity of surfaces or mortar joints to be painted exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove loose rust, loose mill scale, loose shop primer, and other loose foreign matter. Clean using methods recommended in writing by paint manufacturer [.][but not less than the following:]

1. SSPC-SP 2.
2. SSPC-SP 3.
3. SSPC-SP 7/NACE No. 4.
4. SSPC-SP 11.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized Metal Substrates: Remove grease and oil residue from galvanized metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Aluminum Substrates: Remove loose surface oxidation.

J. Wood Substrates:

1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for interior use in paint system indicated.
2. Sand surfaces that will be exposed to view and remove sanding dust.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

K. Canvas and Cotton Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

L. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION OF INTERIOR PAINT PRODUCTS

A. Apply paints in accordance with 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.
4. Paint entire exposed surface of window frames and sashes.
5. Do not paint over labels of independent testing agencies or equipment name,

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identification, performance rating, or nomenclature plates.

6. Primers specified in the applicable interior painting schedule articles may be omitted on items that are factory primed or factory finished if compatible with intermediate and topcoat coatings and acceptable to intermediate and topcoat paint manufacturers.

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 Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed to view in equipment rooms:

    a. Equipment, including panelboards [and switch gear].
    b. Uninsulated metal piping.
    c. Uninsulated plastic piping.
    d. Pipe hangers and supports.
    e. Metal conduit.
    f. Plastic conduit.
    g. Tanks that do not have factory-applied final finishes.
    h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    i. <Insert mechanical items to be painted>.

2. Paint the following work where exposed to view in occupied spaces:

    a. Equipment, including panelboards.
    b. Uninsulated metal piping.
    c. Uninsulated plastic piping.
    d. Pipe hangers and supports.
    e. Metal conduit.
    f. Plastic conduit.
    g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    h. Other items as directed by Architect.
    i. <Insert requirements>.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

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3.4 FIELD QUALITY CONTROL

A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.

1. Touch up and restore painted surfaces damaged by testing.
2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.
3. Cost of retesting is Contractor's responsibility.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
3. Allow empty paint cans to dry before disposal.
4. Collect waste paint by type and deliver to recycling or collection facility.

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.

END OF SECTION 099123

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SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Related Requirements:

1. Section 099123 "Interior Painting" for stains and transparent finishes on concrete floors.
2. Section 099600 "High-Performance Coatings" for transparent high-performance coatings on concrete floors and clay masonry.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
2. Include preparation requirements and application instructions.
3. Indicate VOC content.

B. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

C. Samples for Verification: Sample for each type of finish system and in each color and gloss of finish required on representative samples of actual wood substrates.

1. Size: [8 inches square][or][8 inches long].
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

E. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party Certified Life Cycle Assessment: For each product.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials [, from the same product run,] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

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1. Stains and Transparent Finishes: [5]<Insert number> percent, but not less than [1 gal.]<Insert number> of each material and color applied.

1.4 MOCKUPS

A. Apply mockups of each finish system indicated and each color selected [to verify preliminary selections made under Sample submittals][to demonstrate aesthetic effects][and][to set quality standards for materials and execution].

1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
b. Other Items: Architect will designate items or areas required.

2. Final approval of stain color selections will be based on mockups.

a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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 FIELD CONDITIONS

A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply finishes when relative humidity exceeds 85 percent, at temperatures of less than 5 deg F above the dew point, or to damp or wet surfaces.

C. Do not apply exterior finishes in snow, rain, fog, or mist.

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PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations: Obtain each coating product from single source from single manufacturer.

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 the Work.

B. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.

C. Maximum Moisture Content of Interior Wood Substrates: [15][13][10][9] percent, when measured with an electronic moisture meter.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. Proceed with finish application only after unsatisfactory conditions have been corrected.

1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.

1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

B. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.

1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

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C. Exterior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Prime edges, ends, faces, undersides, and backsides of wood.

    a. For solid hide stained wood, stain edges and ends after priming.
    b. For varnish-coated stained wood, stain edges and ends and prime with varnish. Prime undersides and backsides with varnish.

3. Countersink steel nails, if used, and fill with putty or plastic wood filler tinted to final color. Sand smooth when dried.

D. Interior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Apply wood filler paste to open-grain woods to produce smooth, glasslike finish.
3. Sand surfaces exposed to view and dust off.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dry.

3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions.

1. Use applicators and techniques suited for finish and substrate indicated.
2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from finish application. Correct damage 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 finished wood surfaces.

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3.5 EXTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood Substrates, Glued-Laminated Construction:

1. Solid-Color, Solvent-Based Stain System :

a. Prime Coat: Primer, alkyd for exterior wood.
b. Intermediate Coat: Stain, exterior, solvent based, solid hide, matching topcoat.
c. Topcoat: Stain, exterior, solvent based, solid hide.

2. Varnish over Semitransparent Stain System :

a. Stain Coat: Stain, exterior, solvent based, semitransparent.
b. First Intermediate Coat: Varnish matching topcoat.
c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, with UV inhibitor, exterior, [semigloss][gloss][high gloss].

3. Water-Based Varnish System :

a. Prime Coat: Water-based varnish matching topcoat.
b. Intermediate Coat: Water-based varnish matching topcoat.
c. Topcoat: Water-based varnish, [eggshell][satin][semigloss][gloss][high gloss].

4. Varnish System :

a. Prime Coat: Varnish matching topcoat.
b. First Intermediate Coat: Varnish matching topcoat.
c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, with UV inhibitor, exterior, [semigloss][gloss][high gloss].

5. Clear, Two-Component Polyurethane Varnish over Stain System :

a. Stain Coat: Stain, exterior, solvent based, semitransparent.
b. First Intermediate Coat: Varnish, aliphatic polyurethane, two component, matching topcoat.
c. Second Intermediate Coat: Varnish, aliphatic polyurethane, two component, matching topcoat.
d. Topcoat: Varnish, aliphatic polyurethane, two component, gloss.

6. Clear, Two-Component Polyurethane Varnish System :

a. Prime Coat: Varnish, aliphatic polyurethane, two component, matching topcoat.
b. Topcoat: Varnish, aliphatic polyurethane, two component, gloss.

B. Wood Substrates, Exposed Framing:

1. Solid-Color, Water-Based Stain System :

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a. Prime Coat: Primer, alkyd for exterior wood.
b. Intermediate Coat: Stain, exterior, water based, solid hide, matching topcoat.
c. Topcoat: Stain, exterior, water based, solid hide.

2. Solid-Color, Solvent-Based Stain System :

a. Prime Coat: Primer, alkyd for exterior wood.
b. Intermediate Coat: Stain, exterior, solvent based, solid hide, matching topcoat.
c. Topcoat: Stain, exterior, solvent based, solid hide.

3. Water-Based Semitransparent Stain System :

a. Prime Coat: Stain, exterior, water based, semitransparent, matching topcoat.
b. Intermediate Coat: Stain, exterior, water based, semitransparent, matching topcoat.
c. Topcoat: Stain, exterior, water based, semitransparent.

4. Semitransparent Stain System :

a. Prime Coat: Stain, exterior, solvent based, semitransparent, matching topcoat.
b. Topcoat: Stain, exterior, solvent based, semitransparent.

5. Varnish over Stain System :

a. Stain Coat: Stain, exterior, solvent based, semitransparent.
b. First Intermediate Coat: Varnish matching topcoat.
c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, with UV inhibitor, exterior, [semigloss][gloss][high gloss].

6. Water-Based Varnish System :

a. Prime Coat: Water-based varnish matching topcoat.
b. Intermediate Coat: Water-based varnish matching topcoat.
c. Topcoat: Water-based varnish, [eggshell][satin][semigloss][gloss][high gloss].

7. Varnish System :

a. Prime Coat: Varnish matching topcoat.
b. First Intermediate Coat: Varnish matching topcoat.
c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, with UV inhibitor, exterior, [semigloss][gloss][high gloss].

8. Clear, Two-Component Polyurethane Varnish System :

a. Prime Coat: Varnish, aliphatic polyurethane, two component, matching topcoat.

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b. Intermediate Coat: Varnish, aliphatic polyurethane, two component, matching topcoat.
c. Topcoat: Varnish, aliphatic polyurethane, two component, [gloss][high gloss].

C. Wood Substrates, [Wood Trim][Architectural woodwork][Doors][Windows][Wood Board Siding][and][Wood Fences]:

1. Solid-Color, Water-Based Stain System :

a. Prime Coat: Primer, alkyd for exterior wood.
b. Intermediate Coat: Stain, exterior, water based, solid hide, matching topcoat.
c. Topcoat: Stain, exterior, water based, solid hide.

2. Solid-Color, Solvent-Based Stain System :

a. Prime Coat: Primer, alkyd for exterior wood.
b. Intermediate Coat: Stain, exterior, solvent based, solid hide, matching topcoat.
c. Topcoat: Stain, exterior, solvent based, solid hide.

3. Water-Based Semitransparent Stain System :

a. Prime Coat: Stain, exterior, water based, semitransparent, matching topcoat.
b. Intermediate Coat: Stain, exterior, water based, semitransparent, matching topcoat.
c. Topcoat: Stain, exterior, water based, semitransparent.

4. Semitransparent Stain System :

a. Prime Coat: Stain, exterior, solvent based, semitransparent, matching topcoat.
b. Topcoat: Stain, exterior, solvent based, semitransparent.

5. Varnish over Stain System :

a. Stain Coat: Stain, exterior, solvent-based, semitransparent.
b. First Intermediate Coat: Varnish matching topcoat.
c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, with UV inhibitor, exterior, [semigloss][gloss][high gloss].

6. Water-Based Varnish System :

a. Prime Coat: Water-based varnish matching topcoat.
b. Intermediate Coat: Water-based varnish matching topcoat.
c. Topcoat: Water-based varnish, [eggshell][satin][semigloss][gloss][high gloss].

7. Varnish System :

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a. Prime Coat: Varnish matching topcoat.
b. First Intermediate Coat: Varnish matching topcoat.
c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, with UV inhibitor, exterior, [semigloss][gloss][high gloss].

8. Clear, Two-Component Polyurethane Varnish System :

a. Prime Coat: Varnish, aliphatic polyurethane, two component, matching topcoat.
b. Topcoat: Varnish, aliphatic polyurethane, two component gloss.

D. Wood Substrates, Wood-Based Panel Products:

1. Solid-Color, Water-Based Stain System :

a. Prime Coat: Primer, [latex][alkyd] for exterior wood.
b. Intermediate Coat: Stain, exterior, water based, solid hide, matching topcoat.
c. Topcoat: Stain, exterior, water based, solid hide.

2. Solid-Color, Solvent-Based Stain System :

a. Prime Coat: Primer, alkyd for exterior wood.
b. Intermediate Coat: Stain, exterior, solvent based, solid hide, matching topcoat.
c. Topcoat: Stain, exterior, solvent based, solid hide.

3. Water-Based Semitransparent Stain System :

a. Prime Coat: Stain, exterior, water based, semitransparent, matching topcoat.
b. Intermediate Coat: Stain, exterior, water based, semitransparent, matching topcoat.
c. Topcoat: Stain, exterior, water based, semitransparent.

4. Semitransparent Stain System :

a. Prime Coat: Stain, exterior, solvent based, semitransparent, matching topcoat.
b. Topcoat: Stain, exterior, solvent based, semitransparent.

5. Varnish over Stain System :

a. Stain Coat: Stain, exterior, solvent based, semitransparent.
b. First Intermediate Coat: Varnish matching topcoat.
c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, with UV inhibitor, exterior, [semigloss][gloss][high gloss].

6. Varnish System :

a. Prime Coat: Varnish matching topcoat.

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b. First Intermediate Coat: Varnish matching topcoat.
c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, with UV inhibitor, exterior, [semigloss][gloss][high gloss].

E. Wood Substrates, Traffic Surfaces, Including [Lumber Decking][and][Stairs]:

1. Deck Stain over Wood Preservative System :

a. Preservative Coat: Preservative, for exterior wood.
b. Intermediate Coat: Stain, for exterior wood decks, matching topcoat.
c. Topcoat: Stain, for exterior wood decks.

2. Deck Stain System :

a. Prime Coat: Stain, for exterior wood decks, matching topcoat.
b. Topcoat: Stain, for exterior wood decks.

F. Wood Substrates, Wood Shingles and Shakes (Excluding Roofs):

1. Solid-Color, Water-Based Stain System :

a. Prime Coat: Primer, alkyd for exterior wood.
b. Intermediate Coat: Stain, exterior, water based, solid hide, matching topcoat.
c. Topcoat: Stain, exterior, water based, solid hide.

2. Solid-Color, Solvent-Based Stain System :

a. Prime Coat: Primer, alkyd for exterior wood.
b. Intermediate Coat: Stain, exterior, solvent based, solid hide, matching topcoat.
c. Topcoat: Stain, exterior, solvent based, solid hide.

3. Semitransparent Stain System :

a. Prime Coat: Stain, exterior, solvent based, semitransparent, matching topcoat.
b. Topcoat: Stain, exterior, solvent based, semitransparent.

3.6 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood Substrates, Glued-Laminated Construction:

1. Solid-Color Latex Stain System :

a. Prime Coat: Primer, alkyd for exterior wood.
b. Intermediate Coat: Stain, exterior, water based, solid hide, matching topcoat.
c. Topcoat: Stain, exterior, water based, solid hide.

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2. Solid-Color, Solvent-Based Stain System :

    a. Prime Coat: Stain, exterior, solvent based, solid hide, matching topcoat.
    b. Topcoat: Stain, exterior, solvent based, solid hide.

3. Semitransparent Stain System :

    a. Prime Coat: Stain, semitransparent, matching topcoat.
    b. Topcoat: Stain, semitransparent, for interior wood.

4. Water-Based Varnish over Stain System :

    a. Stain Coat: Stain, semitransparent, for interior wood.
    b. First Intermediate Coat: Water-based varnish matching topcoat.
    c. Second Intermediate Coat: Water-based varnish matching topcoat.
    d. Topcoat: Varnish, water based, clear, [satin][semigloss][gloss].

5. Water-Based Varnish System :

    a. Prime Coat: Water-based varnish matching topcoat.
    b. Intermediate Coat: Water-based varnish matching topcoat.
    c. Topcoat: Varnish, water based, clear, [satin][semigloss][gloss].

6. Alkyd Varnish over Stain System :

    a. Stain Coat: Stain, semitransparent, for interior wood.
    b. First Intermediate Coat: [Varnish matching topcoat][Alkyd, sanding sealer, clear].
    c. Second Intermediate Coat: Varnish matching topcoat.
    d. Topcoat: Varnish, interior, [flat][gloss].

7. Alkyd Varnish System :

    a. Prime Coat: Alkyd, sanding sealer, clear.
    b. Intermediate Coat: Varnish matching topcoat.
    c. Topcoat: Varnish, interior, [flat][gloss].

8. Polyurethane Varnish over Stain System :

    a. Stain Coat: Stain, semitransparent, for interior wood.
    b. First Intermediate Coat: Polyurethane varnish matching topcoat.
    c. Second Intermediate Coat: Polyurethane varnish matching topcoat.
    d. Topcoat: Varnish, interior, polyurethane, oil modified, [satin][gloss].

9. Polyurethane Varnish System :

    a. Prime Coat: Polyurethane varnish matching topcoat.
    b. Intermediate Coat: Polyurethane varnish matching topcoat.
    c. Topcoat: Varnish, interior, polyurethane, oil modified, [satin][gloss].

10. Moisture-Cured Clear Polyurethane over Stain System :

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a. Stain Coat: Stain, semitransparent, for interior wood.
b. First Intermediate Coat: Moisture-cured polyurethane matching topcoat.
c. Second Intermediate Coat: Moisture-cured polyurethane matching topcoat.
d. Topcoat: Varnish, polyurethane, moisture cured, gloss.

11. Clear, Two-Component Polyurethane System :

a. Prime Coat: Two-component polyurethane matching topcoat.
b. Intermediate Coat: Two-component polyurethane matching topcoat.
c. Topcoat: Varnish, aliphatic polyurethane, two component, gloss.

B. Wood Substrates, Exposed Framing:

1. Water-Based Varnish over Stain System :

a. Stain Coat: Stain, semitransparent, for interior wood.
b. First Intermediate Coat: Water-based varnish matching topcoat.
c. Second Intermediate Coat: Water-based varnish matching topcoat.
d. Topcoat: Varnish, water based, clear, [satin][semigloss][gloss].

2. Alkyd Varnish over Stain System :

a. Stain Coat: Stain, semitransparent, for interior wood.
b. First Intermediate Coat: Alkyd, sanding sealer, clear.
c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, interior, [flat][gloss].

3. Alkyd Varnish System :

a. Prime Coat: Alkyd, sanding sealer, clear.
b. Intermediate Coat: Varnish matching topcoat.
c. Topcoat: Varnish, interior, [flat][gloss].

4. Polyurethane Varnish over Stain System :

a. Stain Coat: Stain, semitransparent, for interior wood.
b. First Intermediate Coat: Polyurethane varnish matching topcoat.
c. Second Intermediate Coat: Polyurethane varnish matching topcoat.
d. Topcoat: Varnish, interior, polyurethane, oil modified, [satin][gloss].

5. Polyurethane Varnish System :

a. Prime Coat: Polyurethane varnish matching topcoat.
b. Intermediate Coat: Polyurethane varnish matching topcoat.
c. Topcoat: Varnish, interior, polyurethane, oil modified, [satin][gloss].

6. Moisture-Cured Clear Polyurethane over Stain System :

a. Stain Coat: Stain, semitransparent, for interior wood.
b. First Intermediate Coat: Moisture-cured polyurethane matching topcoat.
c. Second Intermediate Coat: Moisture-cured polyurethane matching topcoat.

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d. Topcoat: Varnish, polyurethane, moisture cured, gloss.

7. Clear, Two-Component Polyurethane System :

a. Prime Coat: Two-component polyurethane matching topcoat.
b. Intermediate Coat: Two-component polyurethane matching topcoat.
c. Topcoat: Varnish, aliphatic polyurethane, two component, gloss.

C. Wood Substrates, [Wood Trim][Architectural Woodwork][Doors][Windows][and][Wood Board Paneling]:

1. Semitransparent Stain System :

a. Prime Coat: Stain, exterior, solvent based, semitransparent, matching topcoat.
b. Topcoat: Stain, exterior, solvent based, semitransparent.

2. Water-Based Varnish over Stain System :

a. Stain Coat: Stain, semitransparent, for interior wood.
b. First Intermediate Coat: Water-based varnish matching topcoat.
c. Second Intermediate Coat: Water-based varnish matching topcoat.
d. Topcoat: Varnish, water based, clear, [satin][semigloss][gloss].

3. Water-Based Varnish System :

a. Prime Coat: Water-based varnish matching topcoat.
b. Intermediate Coat: Water-based varnish matching topcoat.
c. Topcoat: Varnish, water based, clear, [satin][semigloss][gloss].

4. Alkyd Varnish over Stain System :

a. Stain Coat: Stain, semitransparent, for interior wood.
b. First Intermediate Coat: [Alkyd, sanding sealer, clear][Shellac, clear].
c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, interior, [flat][gloss].

5. Alkyd Varnish System :

a. Prime Coat: [Alkyd, sanding sealer, clear][Shellac, clear].
b. Intermediate Coat: Varnish matching topcoat.
c. Topcoat: Varnish, interior, [flat][gloss].

6. Polyurethane Varnish over Stain System :

a. Stain Coat: Stain, semitransparent, for interior wood.
b. First Intermediate Coat: Polyurethane varnish matching topcoat.
c. Second Intermediate Coat: Polyurethane varnish matching topcoat.
d. Topcoat: Varnish, interior, polyurethane, oil modified, [satin][gloss].

7. Polyurethane Varnish System :

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a. Prime Coat: Polyurethane varnish matching topcoat.
b. Intermediate Coat: Polyurethane varnish matching topcoat.
c. Topcoat: Varnish, interior, polyurethane, oil modified, [satin][gloss].

8. Moisture-Cured Clear Polyurethane over Stain System :

a. Stain Coat: Stain, semitransparent, for interior wood.
b. First Intermediate Coat: Moisture-cured polyurethane matching topcoat.
c. Second Intermediate Coat: Moisture-cured polyurethane matching topcoat.
d. Topcoat: Varnish, polyurethane, moisture cured, gloss.

9. Moisture-Cured Clear Polyurethane System :

a. Prime Coat: Moisture-cured polyurethane matching topcoat.
b. Intermediate Coat: Moisture-cured polyurethane matching topcoat.
c. Topcoat: Varnish, polyurethane, moisture cured, gloss.

10. Clear, Two-Component Polyurethane System :

a. Prime Coat: Two-component polyurethane matching topcoat.
b. Intermediate Coat: Two-component polyurethane matching topcoat.
c. Topcoat: Varnish, aliphatic polyurethane, two component, gloss.

11. Danish Oil System :

a. Prime Coat: Danish oil matching topcoat.
b. Topcoat: Danish oil.

D. Wood Substrates, [Wood Paneling][and][Casework]:

1. Semitransparent Stain System :

a. Prime Coat: Stain, exterior, solvent based, semitransparent, matching topcoat.
b. Topcoat: Stain, exterior, solvent based, semitransparent.

2. Water-Based Varnish over Stain System :

a. Stain Coat: Stain, semitransparent, for interior wood.
b. First Intermediate Coat: Water-based varnish matching topcoat.
c. Second Intermediate Coat: Water-based varnish matching topcoat.
d. Topcoat: Varnish, water based, clear, [satin][semigloss][gloss].

3. Water-Based Varnish System :

a. Prime Coat: Water-based varnish matching topcoat.
b. Intermediate Coat: Water-based varnish matching topcoat.
c. Topcoat: Varnish, water based, clear, [satin][semigloss][gloss].

4. Alkyd Varnish over Stain System :

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a. Stain Coat: Stain, semitransparent, for interior wood.
b. First Intermediate Coat: [Alkyd, sanding sealer, clear][Shellac, clear].
c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, interior, [flat][gloss].

5. Alkyd Varnish System :

a. Prime Coat: Alkyd, sanding sealer, clear [Shellac, clear].
b. Intermediate Coat: Varnish matching topcoat.
c. Topcoat: Varnish, interior, [flat][gloss].

6. Polyurethane Varnish over Stain System :

a. Stain Coat: Stain, semitransparent, for interior wood.
b. First Intermediate Coat: Polyurethane varnish matching topcoat.
c. Second Intermediate Coat: Polyurethane varnish matching topcoat.
d. Topcoat: Varnish, interior, polyurethane, oil modified, [satin][gloss].

7. Polyurethane Varnish System :

a. Prime Coat: Polyurethane varnish matching topcoat.
b. Intermediate Coat: Polyurethane varnish matching topcoat.
c. Topcoat: Varnish, interior, polyurethane, oil modified, [satin][gloss].

8. Moisture-Cured Clear Polyurethane over Stain System :

a. Stain Coat: Stain, semitransparent, for interior wood.
b. First Intermediate Coat: Moisture-cured polyurethane matching topcoat.
c. Second Intermediate Coat: Moisture-cured polyurethane matching topcoat.
d. Topcoat: Varnish, polyurethane, moisture cured, gloss.

9. Danish Oil System :

a. Prime Coat: Danish oil matching topcoat.
b. Topcoat: Danish oil.

E. Wood Substrates, Traffic Surfaces, Including [Floors][and][Stairs]:

1. Polyurethane Varnish over Stain System :

a. Stain Coat: Stain, semitransparent, for interior wood.
b. First Intermediate Coat: Polyurethane varnish matching topcoat.
c. Second Intermediate Coat: Polyurethane varnish matching topcoat.
d. Topcoat: Varnish, interior, polyurethane, oil modified, gloss.

2. Polyurethane Varnish System :

a. Prime Coat: Polyurethane varnish matching topcoat.
b. Intermediate Coat: Polyurethane varnish matching topcoat.
c. Topcoat: Varnish, interior, polyurethane, oil modified, gloss.

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3. Moisture-Cured Clear Polyurethane over Stain System :

    a. Stain Coat: Stain, semitransparent, for interior wood.
    b. First Intermediate Coat: Moisture-cured polyurethane matching topcoat.
    c. Second Intermediate Coat: Moisture-cured polyurethane matching topcoat.
    d. Topcoat: Varnish, polyurethane, moisture cured, gloss.

4. Moisture-Cured Clear Polyurethane System :

    a. Prime Coat: Moisture-cured polyurethane matching topcoat.
    b. Intermediate Coat: Moisture-cured polyurethane matching topcoat.
    c. Topcoat: Varnish, polyurethane, moisture cured, gloss.

5. Clear, Two-Component Polyurethane System :

    a. Prime Coat: Two-component polyurethane matching topcoat.
    b. Intermediate Coat: Two-component polyurethane matching topcoat.
    c. Topcoat: Varnish, aliphatic polyurethane, two component, gloss.

F. Wood Substrates, Wood Shingles and Shakes:

1. Solid-Color Latex Stain System :

    a. Prime Coat: Primer, latex for exterior wood.
    b. Intermediate Coat: Stain, exterior, water based, solid hide, matching topcoat.
    c. Topcoat: Stain, exterior, water based, solid hide.

2. Solid-Color, Solvent-Based Stain System :

    a. Prime Coat: Stain, exterior, solvent based, solid hide, matching topcoat.
    b. Topcoat: Stain, exterior, solvent based, solid hide.

3. Semitransparent Stain System :

    a. Prime Coat: Stain, semitransparent, matching topcoat.
    b. Topcoat: Stain, semitransparent, for interior wood.

END OF SECTION 099300

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SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Block fillers.

B. Related Requirements:

1. [Section 051200 "Structural Steel Framing"][Section 051213 "Architecturally Exposed Structural Steel Framing"] for shop priming structural steel substrates with primers specified in this Section.
2. Section 055213 "Pipe and Tube Railings" for shop [priming][painting] pipe and tube railings with coatings specified in this Section.
3. Section 099113 "Exterior Painting" for general field painting.
4. Section 099123 "Interior Painting" for general field painting.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include preparation requirements and application instructions.
2. Indicate VOC content.

B. Samples: For each type of topcoat product.

C. Samples for Initial Selection: For each type of topcoat product.

D. Samples for Verification: For each type of coating system and each color and gloss of topcoat. Submit [actual paint drawdowns as specified below][paint manufacturer's standard printed cards] for verification Samples.

1. Submit Samples on actual substrate material to be coated, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

E. Product List: Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in High-Performance Coating Schedules. Include color designations and production runs (batch numbers).

F. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.

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2. Third-Party-Certified Life-Cycle Assessment: For each product.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials [, from the same production run (batch number),] that match coating system products applied and that are packaged with protective covering for storage and identified with labels describing contents.

1. Coatings: [5]<Insert number> percent, but not less than [1 gal.]<Insert value> of each material and color applied.

1.4 MOCKUPS

A. Apply mockups of each coating system indicated and each color and finish selected to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each coating system.

a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft..
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, 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.
3. <Insert requirements>.

1.6 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F.

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B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each coating system product from single source from single manufacturer.

2.2 HIGH-PERFORMANCE COATING PRODUCTS, GENERAL

A. High-Performance Coating Products: Subject to compliance with requirements, [provide product][provide one of the products][available products that may be incorporated into the Work include but are not limited to products] listed in product types below and applicable exterior and interior high-performance coating schedule articles for the coating category indicated.

B. Material Compatibility:

1. Materials for use within each coating system must be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer based on testing and field experience.
2. For each coat in a coating system, provide products recommended in writing by topcoat manufacturer for use in system and on substrate indicated.

C. Colors: [As selected by Architect from manufacturer's full range][Match Architect's samples][As indicated in color schedule on Drawings]<Insert requirements>.

2.3 SOURCE QUALITY CONTROL

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor to remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, both coatings are incompatible.

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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 the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Cementitious Composition Board: 12 percent.
3. Masonry (Clay and CMUs): 12 percent.
4. Wood: 15 percent.
5. Portland Cement (Plaster Stucco): 12 percent. Verify that plaster is fully cured.
6. Gypsum Board: 12 percent. Verify that finishing compound is dry and sanded smooth.

C. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions applicable to substrates and coating systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

1. Clean surfaces with pressurized water. Use pressure range of

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[1500 to 4000 psi][4000 to 10,000 psi] at 6 to 12 inches.
2. Abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4.

E. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or alkalinity of mortar joints exceeds that permitted in manufacturer's written instructions.

1. Clean surfaces with pressurized water. Use pressure range of [100 to 600 psi][600 to 1500 psi][1500 to 4000 psi] at 6 to 12 inches.

F. Steel Substrates: Remove loose rust, loose mill scale, loose shop primer, and other foreign matter. Clean using methods recommended in writing by coating manufacturer [.][but not less than the following:]

1. SSPC-SP 7/NACE No. 4.
2. SSPC-SP 11.
3. SSPC-SP 6/NACE No. 3.
4. SSPC-SP 10/NACE No. 2.
5. SSPC-SP 5/NACE No. 1.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized Metal Substrates: Remove grease and oil residue from galvanized metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

I. Aluminum Substrates: Remove loose surface oxidation.

J. Wood Substrates:

1. Scrape and clean knots. Before applying primer, apply coat of knot sealer that is recommended in writing by topcoat manufacturer for coating system indicated.
2. Sand surfaces that will be exposed to view and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with filler that is recommended in writing by topcoat manufacturer for coating system indicated. Sand smooth when dried.

3.3 APPLICATION OF HIGH-PERFORMANCE COATINGS

A. Apply coating system products in accordance with manufacturer's written instructions.

1. Use applicators and techniques suited for coating and substrate indicated.
2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

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4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.

1. Touch up and restore coated surfaces damaged by testing.
2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written instructions, apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written instructions.
3. Cost of retesting is Contractor's responsibility.

3.5 CLEANING AND PROTECTION

A. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

B. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

C. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE, CONCRETE SUBSTRATES

A. Vertical (Nontraffic) Surfaces:

1. Epoxy System:

a. Prime Coat: Epoxy, matching topcoat.

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b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, [semigloss][gloss].

2. Pigmented Polyurethane over Epoxy System:

a. Prime Coat: Epoxy, matching intermediate coat.
b. Intermediate Coat: Epoxy, gloss.
c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

B. Horizontal (Traffic) Surfaces:

1. Epoxy Non-Slip Deck Coating System:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Epoxy deck coating (slip resistant).

3.7 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE, CEMENTITIOUS SUBSTRATES

A. Cementitious Composition Board Substrates: [Siding][Trim][Panels]<Insert requirements>.

1. Epoxy-Modified Latex System:

a. Prime Coat: Epoxy-modified latex, matching topcoat.
b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
c. Topcoat: Epoxy-modified latex, [semigloss][gloss].

2. Epoxy System:

a. Prime Coat: Epoxy, matching topcoat.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, [semigloss][gloss].

3. Pigmented Polyurethane over Epoxy System:

a. Prime Coat: Epoxy, gloss.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

B. Portland Cement Plaster (Stucco) Substrates:

1. Epoxy System:

a. Prime Coat: Epoxy, matching topcoat.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, [semigloss][gloss].

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3.8 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE, MASONRY SUBSTRATES

A. Clay Masonry Substrates:

1. Epoxy System:

a. Prime Coat: Epoxy, matching topcoat.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, [semigloss][gloss].

2. Pigmented Polyurethane over Epoxy System:

a. Prime Coat: Epoxy, matching intermediate coat.
b. Intermediate Coat: Epoxy, gloss.
c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

B. CMU Substrates:

1. Epoxy System:

a. Block Filler: Epoxy block filler.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, [semigloss][gloss].

2. Pigmented Polyurethane over High-Build Epoxy System:

a. Block Filler: Epoxy block filler, epoxy.
b. Intermediate Coat: Epoxy, high build, low gloss.
c. Topcoat: Pigmented polyurethane [semigloss][gloss].

3.9 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE, METAL SUBSTRATES

A. Steel Substrates:

1. Epoxy System:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal.
b. Intermediate Coat: Epoxy, high build, low gloss.
c. Topcoat: Epoxy, [semigloss][gloss].

2. Epoxy over Self-Priming Epoxy System:

a. Prime Coat: Epoxy, high build, self-priming.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, [semigloss][gloss].

3. Epoxy Deck Coating over Epoxy Primer and High-Build Epoxy System:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal.

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b. Intermediate Coat: Epoxy, high build, low gloss.
c. Topcoat: Epoxy deck coating (slip resistant).
d. Additive: Manufacturer's standard additive to increase skid resistance of painted surface.

4. Epoxy Deck Coating over Self-Priming Epoxy System:

a. Prime Coat: Epoxy, high build, self-priming.
b. Topcoat: Epoxy deck coating (slip resistant).
c. Additive: Manufacturer's standard additive to increase skid resistance of painted surface.

5. Pigmented Polyurethane over Epoxy System:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal.
b. Intermediate Coat: Epoxy, gloss.
c. First and Second Topcoat: Pigmented polyurethane, [semigloss][gloss].

6. Pigmented Polyurethane over High-Build Epoxy System:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal.
b. Intermediate Coat: Epoxy, high build, low gloss.
c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

7. Pigmented Polyurethane over Self-Priming Epoxy System:

a. Prime Coat: Epoxy, high build, self-priming.
b. Intermediate Coat: Polyurethane, matching topcoat.
c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

8. Pigmented Polyurethane over Epoxy Zinc-Rich Primer System:

a. Prime Coat: Primer, zinc rich, epoxy.
b. Intermediate Coat: Epoxy, gloss.
c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

9. Pigmented Polyurethane over Epoxy Zinc-Rich Primer and High-Build Epoxy System:

a. Prime Coat: Primer, zinc rich, epoxy.
b. Intermediate Coat: Epoxy, high build, low gloss.
c. First and Second Topcoat: Pigmented polyurethane, [semigloss][gloss].

10. Pigmented Polyurethane over Inorganic Zinc-Rich Primer and High-Build Epoxy System:

a. Prime Coat: Primer, zinc rich, inorganic.
b. Intermediate Coat: Epoxy, high build, low gloss.
c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

B. Galvanized Metal Substrates:

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1. Epoxy System:

    a. Prime Coat: Primer, epoxy, anti-corrosive, for metal.
    b. Intermediate Coat: Epoxy, matching topcoat.
    c. Topcoat: Epoxy, [semigloss][gloss].

2. Pigmented Polyurethane over Epoxy Primer System:

    a. Prime Coat: Primer, epoxy, anti-corrosive, for metal.
    b. Intermediate Coat: Polyurethane, matching topcoat.
    c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

3. Pigmented Polyurethane over Vinyl Wash Primer and Epoxy Primer System:

    a. Prime Coat: Primer, vinyl wash.
    b. Intermediate Coat: Primer, epoxy, anti-corrosive, for metal.
    c. First and Second Topcoat: Pigmented polyurethane, [semigloss][gloss].

C. Aluminum (Not Anodized or Otherwise Coated) Substrates:

1. Epoxy System:

    a. Prime Coat: Primer, vinyl wash.
    b. Intermediate Coat: Epoxy, matching topcoat.
    c. Topcoat: Epoxy, [semigloss][gloss].

2. Pigmented Polyurethane over Epoxy System:

    a. Prime Coat: Primer, vinyl wash.
    b. Intermediate Coat: Primer, epoxy, anti-corrosive, for metal.
    c. First and Second Topcoat: Pigmented polyurethane, [semigloss][gloss].

D. Copper Substrates:

1. Epoxy System:

    a. Prime Coat: Primer, vinyl wash.
    b. Intermediate Coat: Epoxy, matching topcoat.
    c. Topcoat: Epoxy, [semigloss][gloss].

2. Pigmented Polyurethane over Epoxy System:

    a. Prime Coat: Primer, vinyl wash.
    b. Intermediate Coat: Primer, epoxy, anti-corrosive, for metal.
    c. First and Second Topcoat: Pigmented polyurethane, [semigloss][gloss].

E. Stainless Steel Substrates:

1. Epoxy System:

    a. Prime Coat: Primer, epoxy, anti-corrosive, for metal.

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b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, [semigloss][gloss].

2. Pigmented Polyurethane System:

a. Prime Coat: Primer, vinyl wash.
b. Intermediate Coat: Primer, epoxy, anti-corrosive, for metal.
c. First and Second Topcoat: Pigmented polyurethane, [semigloss][gloss].

3.10 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE, WOOD SUBSTRATES

A. Glued-Laminated Wood Substrates:

1. Pigmented Polyurethane System:

a. Prime Coat: Polyurethane, matching topcoat.
b. Intermediate Coat: Polyurethane, matching topcoat.
c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

2. Clear (Two-Component) Polyurethane System:

a. Stain Coat: Stain, exterior, solvent based, semitransparent.
b. Prime Coat: Polyurethane, matching topcoat.
c. Intermediate Coat: Polyurethane, matching topcoat.
d. Topcoat: Varnish, aliphatic polyurethane.

B. Exposed Wood-Framed Substrates:

1. Pigmented Polyurethane System:

a. Prime Coat: Polyurethane, matching topcoat.
b. Intermediate Coat: Polyurethane, matching topcoat.
c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

2. Clear (Two-Component) Polyurethane System:

a. Prime Coat: Polyurethane, matching topcoat.
b. Intermediate Coat: Polyurethane, matching topcoat.
c. Topcoat: Varnish, aliphatic polyurethane.

C. Dressed Wood Substrates: [Wood trim][Architectural woodwork][Doors][Windows][Wood board siding][Railings][and][Fences]<Insert requirements>.

1. Pigmented Polyurethane System:

a. Prime Coat: Polyurethane, matching topcoat.
b. Intermediate Coat: Polyurethane, matching topcoat.
c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

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2. Clear (Two-Component) Polyurethane System:

    a. Prime Coat: Polyurethane, matching topcoat.
    b. Intermediate Coat: Polyurethane, matching topcoat.
    c. Topcoat: Varnish, aliphatic polyurethane.

3.11 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE, MISCELLANEOUS SUBSTRATES

A. Fiberglass Substrates:

1. Epoxy System:

    a. Prime Coat: Epoxy, matching topcoat.
    b. Intermediate Coat: Epoxy, matching topcoat.
    c. Topcoat: Epoxy, [semigloss][gloss].

2. Epoxy-Modified Latex System:

    a. Prime Coat: Epoxy-modified latex, matching topcoat.
    b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
    c. Topcoat: Epoxy-modified latex, [semigloss][gloss].

3. Pigmented Polyurethane over Epoxy System:

    a. Prime Coat: Epoxy, matching intermediate coat.
    b. Intermediate Coat: Epoxy, gloss.
    c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

3.12 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE, CONCRETE SUBSTRATES

A. Vertical (Nontraffic) Surfaces:

1. Epoxy System:

    a. Prime Coat: Epoxy, matching topcoat.
    b. Intermediate Coat: Epoxy, matching topcoat.
    c. Topcoat: Epoxy, [semigloss][gloss].

2. Epoxy, High-Build System:

    a. Prime Coat: High-build epoxy, matching topcoat (reduced).
    b. Intermediate Coat: High-build epoxy, matching topcoat.
    c. Topcoat: High-build epoxy, low gloss.

3. Epoxy-Modified Latex System:

    a. Prime Coat: Epoxy-modified latex, matching topcoat.

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b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
c. Topcoat: Epoxy-modified latex, [semigloss][gloss].

B. Horizontal (Traffic) Surfaces.

1. Epoxy System:

a. Prime Coat: Epoxy, matching topcoat.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, [semigloss][gloss].

2. Epoxy, High-Build System:

a. Prime Coat: High-build epoxy, matching topcoat (reduced).
b. Intermediate Coat: High-build epoxy, matching topcoat.
c. Topcoat: High-build epoxy, [low gloss][gloss].

3. Pigmented Polyurethane System:

a. Prime Coat: Epoxy, gloss.
b. Intermediate Coat: Polyurethane, matching topcoat.
c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

4. Clear (Two-Component) Polyurethane System:

a. Prime Coat: Polyurethane, matching topcoat.
b. Intermediate Coat: Polyurethane, matching topcoat.
c. Topcoat: Varnish, aliphatic polyurethane.

3.13 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE, CEMENTITIOUS SUBSTRATES

A. Cementitious Composition Board Substrates: [Siding][Trim][Panels]<Insert requirements>.

1. Epoxy System:

a. Prime Coat: Epoxy, matching topcoat.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, [semigloss][gloss].

2. Epoxy-Modified Latex System:

a. Prime Coat: Epoxy-modified latex, matching topcoat.
b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
c. Topcoat: Epoxy-modified latex, [semigloss][gloss].

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3.14 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE, MASONRY SUBSTRATES

A. Clay Masonry Substrates:

1. Epoxy System:

   a. Prime Coat: Epoxy, matching topcoat.
   b. Intermediate Coat: Epoxy, matching topcoat.
   c. Topcoat: Epoxy, [semigloss][gloss].

2. Epoxy-Modified Latex System:

   a. Prime Coat: Epoxy-modified latex, matching topcoat.
   b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
   c. Topcoat: Epoxy-modified latex, [semigloss][gloss].

3. Clear (Two-Component) Polyurethane System:

   a. Prime Coat: Polyurethane, matching topcoat.
   b. Intermediate Coat: Polyurethane, matching topcoat.
   c. Topcoat: Varnish, aliphatic polyurethane.

B. CMU Substrates:

1. Epoxy System for Dry Environments:

   a. Block Filler: Latex block filler.
   b. Intermediate Coat: Epoxy, matching topcoat.
   c. Topcoat: Epoxy, [semigloss][gloss].

2. Epoxy System for Wet Environments:

   a. Block Filler: Epoxy block filler.
   b. Intermediate Coat: Epoxy, matching topcoat.
   c. Topcoat: Epoxy, [semigloss][gloss].

3. Epoxy, High-Build System:

   a. Prime Coat: Epoxy block filler.
   b. Intermediate Coat: High-build epoxy, matching topcoat.
   c. Topcoat: High-build epoxy, [low gloss][gloss].

4. Epoxy-Modified Latex System:

   a. Block Filler: Latex block filler.
   b. Intermediate Coat: Epoxy-modified latex, interior, matching topcoat.
   c. Topcoat: Epoxy-modified latex, [semigloss][gloss].

5. Clear (Two-Component) Polyurethane System:

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a. Prime Coat: Polyurethane, matching topcoat.
b. Intermediate Coat: Polyurethane, matching topcoat.
c. Topcoat: Varnish, aliphatic polyurethane.

3.15 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE, METAL SUBSTRATES

A. Steel Substrates:

1. Epoxy System:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, [semigloss][gloss].

2. High-Build Epoxy over Epoxy Zinc-Rich Primer System:

a. Prime Coat: Primer, zinc-rich, epoxy.
b. Intermediate Coat: Epoxy, high build, low gloss.
c. Topcoat: Epoxy, [low gloss][gloss].

3. Epoxy over Self-Priming Epoxy System:

a. Prime Coat: Epoxy, high build, self-priming.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, [semigloss][gloss].

4. Epoxy, High-Build System:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal.
b. Intermediate Coat: High-build epoxy, matching topcoat.
c. Topcoat: High-build epoxy, [low gloss][gloss].

5. Epoxy Deck Coating System:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal.
b. Intermediate Coat: Epoxy.
c. Topcoat: Epoxy deck coating (slip resistant).

6. Epoxy-Modified Latex System:

a. Prime Coat, First Coat: Primer, rust inhibitive, water based.
b. Prime Coat, Second Coat: Primer, rust inhibitive, water based.
c. Intermediate Coat: Epoxy-modified latex, matching topcoat.
d. Topcoat: Epoxy-modified latex, [semigloss][gloss].

7. Pigmented Polyurethane over Epoxy Primer System:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal.
b. Intermediate Coat: Polyurethane, matching topcoat.
c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

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8. Pigmented Polyurethane over High-Build Epoxy System:

    a. Prime Coat: Primer, epoxy, anti-corrosive, for metal.
    b. Intermediate Coat: Epoxy, high build, low gloss.
    c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

9. Pigmented Polyurethane over Self-Priming Epoxy System:

    a. Prime Coat: Epoxy, high build, self-priming.
    b. Intermediate Coat: Polyurethane, matching topcoat.
    c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

10. Pigmented Polyurethane over Inorganic Zinc-Rich and Epoxy System:

    a. Prime Coat: Primer, zinc rich, inorganic.
    b. Intermediate Coat: Epoxy.
    c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

11. Pigmented Polyurethane over Epoxy Zinc-Rich and Epoxy System:

    a. Prime Coat: Primer, zinc rich, epoxy.
    b. Intermediate Coat: Epoxy, gloss.
    c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

B. Galvanized Metal Substrates:

1. Epoxy over Epoxy Primer System:

    a. Prime Coat: Primer, epoxy, anti-corrosive, for metal.
    b. Intermediate Coat: Epoxy, matching topcoat.
    c. Topcoat: Epoxy, [semigloss][gloss].

C. Aluminum (Not Anodized or Otherwise Coated) Substrates:

1. Epoxy System:

    a. Prime Coat: Primer, vinyl wash.
    b. Intermediate Coat: Epoxy, matching topcoat.
    c. Topcoat: Epoxy, [semigloss][gloss].

2. Pigmented Polyurethane System:

    a. Prime Coat: Primer, vinyl wash.
    b. Intermediate Coat: Epoxy, gloss.
    c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

D. Copper Substrates:

1. Epoxy System:

    a. Prime Coat: Primer, vinyl wash.

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b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, [semigloss][gloss].

2. Pigmented Polyurethane System:

a. Prime Coat: Primer, vinyl wash.
b. Intermediate Coat: Epoxy, gloss.
c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

E. Stainless Steel Substrates:

1. Epoxy System:

a. Prime Coat: Primer, epoxy.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, [semigloss][gloss].

2. Pigmented Polyurethane System:

a. Prime Coat: Primer, vinyl wash.
b. Intermediate Coat: Epoxy, gloss.
c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

3.16 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE, WOOD SUBSTRATES

A. Glued-Laminated Wood Substrates:

1. Epoxy System:

a. Prime Coat: Epoxy, matching topcoat.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, [semigloss][gloss].

2. Pigmented Polyurethane System:

a. Prime Coat: Polyurethane, matching topcoat.
b. Intermediate Coat: Polyurethane, matching topcoat.
c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

3. Clear (Two-Component) Polyurethane System:

a. Prime Coat: Polyurethane, matching topcoat.
b. Intermediate Coat: Polyurethane, matching topcoat.
c. Topcoat: Varnish, aliphatic polyurethane, .

B. Exposed Wood-Framed Substrates:

1. Clear (Two-Component) Polyurethane System:

a. Prime Coat: Polyurethane, matching topcoat.

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b. Intermediate Coat: Polyurethane, matching topcoat.
c. Topcoat: Varnish, aliphatic polyurethane.

C. Dressed Wood Substrates: [Wood trim][Architectural woodwork][Doors][Windows][and][Wood board paneling].

1. Epoxy System:

a. Prime Coat: Epoxy, matching topcoat.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, [semigloss][gloss].

2. Clear (Two-Component) Polyurethane System:

a. Prime Coat: Polyurethane, matching topcoat.
b. Intermediate Coat: Polyurethane, matching topcoat.
c. Topcoat: Varnish, aliphatic polyurethane.

D. Wood-Traffic Substrates: [Floors][and][stairs].

1. Clear (Two-Component) Polyurethane System:

a. Prime Coat: Polyurethane, matching topcoat.
b. Intermediate Coat: Polyurethane, matching topcoat.
c. Topcoat: Varnish, aliphatic polyurethane, .
d. Additive: Manufacturer's standard additive to increase skid resistance of coated surface.

3.17 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE, GYPSUM-BASED SUBSTRATES

A. Gypsum Board and Plaster Substrates:

1. Epoxy System:

a. Prime Coat: Primer sealer, latex, interior.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, [semigloss][gloss].

2. Epoxy, High-Build System:

a. Prime Coat: Primer sealer, latex, interior.
b. Intermediate Coat: High-build epoxy, matching topcoat.
c. Topcoat: High-build epoxy, [low gloss][gloss].

3. Epoxy-Modified Latex System:

a. Prime Coat: Primer sealer, latex, interior.
b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
c. Topcoat: Epoxy-modified latex, [semigloss][gloss].

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3.18 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE, MISCELLANEOUS SUBSTRATES

A. Fiberglass Substrates:

1. Epoxy System:

   a. Prime Coat: Epoxy, matching topcoat.
   b. Intermediate Coat: Epoxy, matching topcoat.
   c. Topcoat: Epoxy, [semigloss][gloss].

2. Pigmented Polyurethane System:

   a. Prime Coat: Epoxy, gloss.
   b. Intermediate Coat: Epoxy, matching topcoat.
   c. Topcoat: Pigmented polyurethane, [semigloss][gloss].

3. Epoxy-Modified Latex System:

   a. Epoxy-modified latex, matching topcoat.
   b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
   c. Topcoat: Epoxy-modified latex, [semigloss][gloss].

END OF SECTION 099600

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SECTION 101100 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Visual display board assemblies.
2. Visual display conference units.
3. Natural-slate chalkboards.

B. Related Requirements:

1. Section 097723 "Fabric-Wrapped Panels" for tackable, fabric-covered panels mounted on walls.
2. Section 101146 "Visual Display Fabrics" for visual display wall coverings intended for use with dry-erase markers.
3. Section 101200 "Display Cases" for [individually framed and enclosed, wall-mounted bulletin boards][and for][tackboards within display cases].

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]<Insert location>.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Visual display board assemblies.
2. Floor-to-ceiling visual display assemblies.
3. Rail support system for visual display board assemblies.
4. Modular support system for visual display board assemblies.
5. Sliding visual display units.
6. Visual display conference units.
7. Glass markerboards.
8. Display rails.
9. Natural-slate chalkboards.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
2. Include electrical characteristics for motorized units.

C. Shop Drawings: For visual display units.

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1. Include plans, elevations, sections, details, and attachment to other work.
2. Show locations of panel joints. [Show locations of field-assembled joints for factory-fabricated units too large to ship in one piece.]
3. Show locations and layout of special-purpose graphics.
4. Include sections of typical trim members.
5. Include wiring diagrams for power and control wiring.

D. Samples for Initial Selection: For each type of visual display unit indicated, for units with factory-applied color finishes, and as follows:

1. Samples of facings for each visual display panel type, indicating color and texture.
2. Fabric swatches of fabric facings for tackboards.
3. Actual factory-finish color samples, applied to [aluminum][wood] substrate.
4. Include accessory Samples to verify color selected.

E. Samples for Verification: For each type of visual display unit indicated.

1. Visual Display Panel: Not less than 8-1/2 by 11 inches, with facing, core, and backing indicated for final Work. Include one panel for each type, color, and texture required.
2. Trim: 6-inch- long sections of each trim profile.
3. Display Rail: 6-inch- long section of each type.
4. [Rail][Modular] Support System: 6-inch- long sections.
5. Accessories: Full-size Sample of each type of accessory.

F. Product Schedule: For visual display units. [Use same designations indicated on Drawings.]

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each visual display unit, for tests performed by [manufacturer and witnessed by a qualified testing agency][a qualified testing agency].

C. Sample Warranties: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For visual display units [and motorized units] 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.

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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 [wall area][visual display unit][floor-to-ceiling visual display assembly]<Insert description> as shown on Drawings. Include 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.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.9 WARRANTY

A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Surfaces lose original writing and erasing qualities.
b. Surfaces exhibit crazing, cracking, or flaking.

2. Warranty Period:

a. [50]<Insert number> years from date of Substantial Completion.
b. Life of the building.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: [25]<Insert value> or less.
2. Smoke-Developed Index: [50][450]<Insert value> or less.

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.

2.2 VISUAL DISPLAY BOARD ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

1. Aarco Products, Inc.
2. ASI Visual Display Products
3. Claridge Products and Equipment, LLC.

B. Visual Display Board Assembly: factory fabricated.

1. Assembly: tackboard.
2. Corners: Square.
3. Width: [As indicated on Drawings]<Insert dimension>.
4. Height: [As indicated on Drawings]<Insert dimension>.
5. Mounting Method: Direct to wall.

C. Tackboard Panel: Natural-cork tackboard panel on core indicated.

1. Fabric Wrapped Edge: Wrap edge of tackboard panel with fabric facing.
2. Color and Pattern: As selected by Architect from full range of industry colors.

D. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- thick, extruded aluminum; of size and shape indicated on Drawings.

1. Field-Applied Trim: Manufacturer's standard, snap-on trim with no visible screws or exposed joints.
2. Aluminum Finish: Clear anodic finish.

a. Color: As selected by Architect from full range of industry colors and color densities.

E. Joints: Make joints only where total length exceeds maximum manufactured length.

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Fabricate with minimum number of joints, as indicated on approved Shop Drawings.

F. Combination Assemblies: Provide H-trim between abutting sections of visual display panels.

G. Chalktray: Manufacturer's standard; continuous.

1. Box Type: Extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.
2. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.

2.3 VISUAL DISPLAY CONFERENCE UNITS

A. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

1. AJW Architectural Products
2. Platinum Visual Solutions

2.4 TACKBOARD PANELS

A. Tackboard Panels:

1. Facing:

a. natural cork.
b. Vinyl fabric factory laminated to 1/4-inch- thick, cork sheet.

2. Core:

a. Manufacturer's standard.
b. 3/8-inch- thick fiberboard.
c. 1/4-inch- thick hardboard.

2.5 MATERIALS

A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.

B. High-Pressure Decorative Laminate: ISO 4586-3.

C. High-Pressure Markerboard Laminate: Complying with physical testing requirements of ISO 4586-3.

D. High-Pressure Chalkboard Laminate: Complying with physical testing requirements of

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ISO 4586-3.

E. Natural-Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish [; with surface-burning characteristics indicated].

F. Plastic-Impregnated-Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout [; with surface-burning characteristics indicated].

G. Vinyl Fabric: Mildew resistant, washable, complying with ASTM F793/F793M, Type II, [burlap weave]<Insert texture or pattern>; weighing not less than 13 oz./sq. yd.; with surface-burning characteristics indicated.

H. Polyester Fabric: Nondirectional weave, 100 percent polyester; weighing not less than 15 oz./sq. yd.; with surface-burning characteristics indicated.

I. Hardboard: ANSI A135.4, tempered.

J. Particleboard: ANSI A208.1, Grade M-1.

K. MDF: ANSI A208.2, Grade 130.

L. Fiberboard: ASTM C208 cellulosic fiber insulating board.

M. Clear Tempered Glass: ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering.

N. Extruded Aluminum: ASTM B221, Alloy 6063.

O. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.

P. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements in [Section 099123 "Interior Painting"]<Insert Section number and title> and recommended in writing by visual display unit manufacturer for intended substrate.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA AMP 500 for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: 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.

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2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603, except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of motorized, sliding visual display units.

C. Examine walls and partitions for proper preparation and backing for visual display units.

D. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.

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

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.

C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.

D. Prime wall surfaces indicated to receive [visual display units][direct-applied, floor-to-ceiling visual display assemblies] and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.

E. Prepare recesses for sliding visual display units as required by type and size of unit.

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3.3 INSTALLATION

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Field-Assembled Visual Display Board Assemblies: Coordinate field-assembled units with grounds, trim, and accessories indicated. Join parts with a neat, precision fit.

1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, [balanced around center of board, as acceptable to Architect][as indicated on approved Shop Drawings].
2. Where size of visual display board assemblies or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.

C. Factory-Fabricated Visual Display Board Assemblies:

1. Adhere to wall surfaces with [egg-size]<Insert coverage> adhesive gobs at 16 inches o.c., horizontally and vertically.
2. Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches o.c. Secure tops and bottoms of boards to walls.

D. Natural-Slate Chalkboards: Align and level joints between adjoining panels, and apply manufacturer's recommended joint-filler compound. Hone and finish joints to continuous even plane.

E. Visual Display Board Assembly Mounting Heights: Install visual display units at mounting heights indicated on Drawings, or if not indicated, at heights indicated below.

1. Mounting Height [for Grades K through 3]<Insert description>: [24 inches]<Insert dimension> above finished floor to top of chalktray.
2. Mounting Height [for Grades 4 through 6]<Insert description>: [28 inches]<Insert dimension> above finished floor to top of chalktray.
3. Mounting Height [for Grades 7 and Higher]<Insert description>: [36 inches]<Insert dimension> above finished floor to top of chalktray.

F. Floor-to-Ceiling Markerboard Panels: Attach panels to wall surface with [egg-size]<Insert coverage> adhesive gobs at 16 inches o.c., horizontally and vertically.

1. Join adjacent panels with concealed steel splines for smooth alignment.
2. Join adjacent panels with exposed, H-shaped aluminum trim painted to match wall panel.

G. Floor-to-Ceiling Tackboard Panels: Attach panels to wall surface with [egg-size]<Insert coverage> adhesive gobs at 16 inches o.c., horizontally and vertically.

1. Install wrapped-edge panels with butt joints between adjacent wall panels.

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2. Join adjacent panels with exposed, H-shaped aluminum trim covered with same fabric as wall panels.

H. Rail Support System: Install horizontal support rail at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall with fasteners at 12 inches o.c.

1. Mounting Height: [72 inches]<Insert dimension> above finished floor to top of rail.
2. Hang visual display units on rail support system.

I. Modular Support System: Install adjustable standards at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Install standards at 48 inches o.c., vertically aligned and plumb, and attached to wall with fasteners at 12 inches o.c.

1. Mounting Height: [12 inches]<Insert dimension> above finished floor to bottom of standard.
2. Install single-slotted standard at each end of each run of standards and double-slotted standards at intermediate locations.
3. Provide locking screw at top corner of visual display board at each standard.
4. Hang visual display units on modular support system.

J. Sliding Visual Display Units: Install units at mounting heights indicated. Attach to wall framing with fasteners at not more than 16 inches o.c.

1. Adjust panels to operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

K. Visual Display Conference Units: Install units at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall surface with [fasteners through back of cabinet][concealed brackets screwed to wall][concealed wood cleats screwed to wall].

1. Mounting Height: [72 inches]<Insert dimension> above finished floor to top of cabinet.

3.4 CLEANING AND PROTECTION

A. Clean visual display units in accordance with manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display units after installation and cleaning.

3.5 DEMONSTRATION

A. [Engage a factory-authorized service representative to train][Train] Owner's maintenance personnel to adjust, operate, and maintain motorized, sliding visual display units.

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END OF SECTION 101100

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SECTION 101416 - PLAQUES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal plaques.

B. Related Requirements:

1. Section 101423 "Panel Signage" and Section 101423.16 "Room-Identification Panel Signage" for plaques or signs similar to metal plaques, with or without frames, except that they are made of materials other than solid metal.
2. [Section 142100 "Electric Traction Elevators"][Section 142400 "Hydraulic Elevators"][Section 143100 "Escalators"][Section 143200 "Moving Walks"][Section 144200 "Wheelchair Lifts"] for code-required conveying equipment signage.
3. Section 220553 "Identification for Plumbing Piping and Equipment" for labels, tags, and nameplates for plumbing systems and equipment.
4. Section 230553 "Identification for HVAC Piping and Equipment" for labels, tags, and nameplates for HVAC systems and equipment.
5. Section 260553 "Identification for Electrical Systems" for labels, tags, and nameplates for electrical equipment.

1.2 ALLOWANCES

A. Allowances for [signage][plaques][and][plaques used for room identification]<Insert item description> are specified in Section 012100 "Allowances."

B. <Insert product or material>[is][are] part of <Insert name of allowance>.

1.3 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.4 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

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B. Shop Drawings: For plaques.

1. Include fabrication and installation details and attachments to other work.
2. Show plaque mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements [, including raised characters and Braille], and layout for each plaque at least [half size]<Insert scale>.

C. Samples for Initial Selection: For each type of plaque, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of plaque showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Plaques: [Full-size Sample][Half-size Sample]<Insert size>.
2. Exposed Accessories: [Full-size Sample][Half-size Sample]<Insert size> of each accessory type.
3. Full-size Samples, if approved, will be returned to Contractor for use in the Project.

E. Product Schedule: For plaques. Use same designations indicated on Drawings or specified.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For [Installer][and][manufacturer].

B. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For plaques to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: [Manufacturer of products][An entity that employs installers and supervisors who are trained and approved by manufacturer].

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of plaques that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

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a. Deterioration of finishes beyond normal weathering.
b. Deterioration of embedded graphic image.

2. Warranty Period: [Five]<Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in [the USDOJ's "2010 ADA Standards for Accessible Design"][the ABA standards of the Federal agency having jurisdiction][and][ICC A117.1]<Insert requirement>.

2.2 METAL PLAQUES

A. Cast Plaque: Cast-metal plaque with background texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. Erie Landmark Company; a division of Paul W. Zimmerman Foundaries, Inc.
    b. Gemini Signage; Gemini, Inc.
    c. Metallic Arts

2. Plaque Material: Cast aluminum.
3. Plaque Thickness: 0.50 inch.
4. Finishes:

    a. Integral Metal Finish: As selected by Architect from full range of industry finishes.
    b. Integral Aluminum Finish: Anodized color as selected by Architect from full range of industry colors and color densities.
    c. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.
    d. Overcoat: Manufacturer's standard baked-on clear coating.

5. Background Texture: As selected by Architect from manufacturer's full range.
6. Integrally Cast Border Style: As indicated on Drawings.
7. Applied Frame Material, Style, and Finish: [As indicated on Drawings]<Insert description>.
8. Mounting: Countersunk flathead through fasteners.
9. Text and Typeface: Typeface as selected by Architect from manufacturer's full

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range. [Finish raised characters to contrast with background color, and finish Braille to match background color.]

2.3 MATERIALS

A. Aluminum Castings: ASTM B26/B26M, alloy and temper recommended by plaque manufacturer for casting process used and for type of use and finish indicated.

B. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Aluminum Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

D. Brass Castings: ASTM B584, [alloy recommended by manufacturer and finisher for finish indicated][lead-free alloy recommended by manufacturer and finisher for finish indicated][Alloy UNS No. C85200 (high-copper yellow brass)]<Insert requirement>.

E. Brass Sheet (Yellow Brass): ASTM B36/B36M, [alloy recommended by manufacturer and finisher for finish indicated][lead-free alloy recommended by manufacturer and finisher for finish indicated][Alloy UNS No. C26000 (yellow brass)]<Insert requirement>.

F. Bronze Castings: ASTM B584, [alloy recommended by manufacturer and finisher for finish indicated][lead-free alloy recommended by manufacturer and finisher for finish indicated][Alloy UNS No. C86500 (No. 1 manganese bronze)]<Insert requirement>.

G. Bronze Plate: ASTM B36/B36M, [alloy recommended by manufacturer and finisher for finish indicated][lead-free alloy recommended by manufacturer and finisher for finish indicated][Alloy UNS No. C22000 (commercial bronze)]<Insert requirement>.

H. Copper Sheet: ASTM B152/B152M.

I. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, [Type 304,][Type 316,] stretcher-leveled standard of flatness.

J. Zinc Castings: ASTM B240, alloy and temper recommended by plaque manufacturer for type of use and finish indicated.

K. Zinc Sheet: [ASTM B69]<Insert standard>, alloy and temper recommended by plaque manufacturer for type of use and finish indicated.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of plaques, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish [nonferrous-metal][stainless steel][or][hot-dip

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galvanized]<Insert requirement> devices unless otherwise indicated.

3. Exposed Metal-Fastener Components, General:

    a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
    b. Fastener Heads: For nonstructural connections, use [flathead][or][oval countersunk]<Insert shape> screws and bolts with tamper-resistant [Allen-head][spanner-head][or][one-way-head]<Insert slot design> slots unless otherwise indicated.

4. Plaque Mounting Fasteners:

    a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of plaque, screwed into back of plaque, or screwed into tapped lugs cast integrally into back of plaque unless otherwise indicated.
    b. Through Fasteners: Exposed metal fasteners matching plaque finish, with type of head indicated, installed in predrilled holes.

B. Adhesive: As recommended by plaque manufacturer.

C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.5 FABRICATION

A. General: Provide manufacturer's standard plaques according to requirements indicated.

1. Preassemble plaques in the shop to greatest extent possible. Disassemble plaques only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
5. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match plaque finish.
6. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

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B. Surface-Engraved Graphics: Machine-engrave characters and other graphic devices into indicated plaque surface to produce precisely formed copy, incised to uniform depth.

1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.

C. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted plaques to suit plaque construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish [to match plaque-background color][to match Architect's sample]<Insert requirement> color unless otherwise indicated.
2. Stainless Steel Brackets: Factory finish brackets [to match plaque background][to match Architect's sample][with No. 4]<Insert finish> finish unless otherwise indicated.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, [Class I, 0.018 mm][Class II, 0.010 mm] or thicker.

B. Color Anodic Finish: AAMA 611, [Class I, 0.018 mm][Class II, 0.010 mm] or thicker.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

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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.

B. Verify that plaque-support surfaces are within tolerances to accommodate plaques without gaps or irregularities between backs of plaques and support surfaces unless otherwise indicated.

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

3.2 INSTALLATION OF METAL PLAQUES

A. General: Install plaques using mounting methods indicated and according to manufacturer's written instructions.

1. Install plaques level, plumb, true to line, and at locations and heights indicated, with plaque surfaces free of distortion and other defects in appearance.
2. Install plaques so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that plaque surfaces are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Plaques Used for Room Identification [and Other Accessible Plaques]: Install in locations on walls [as indicated on Drawings][and][according to accessibility standard]<Insert requirement>.

C. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of plaque. Remove loose debris from hole and substrate surface.

    a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place plaque in position and push until flush to surface, embedding studs in holes. Temporarily support plaque in position until adhesive fully sets.
    b. Thin or Hollow Surfaces: Place plaque in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Through Fasteners: Drill holes in substrate using predrilled holes in plaque as template. Countersink holes in plaque if required. Place plaque in position and flush to surface. Install through fasteners and tighten.
3. Brackets: Remove loose debris from substrate surface and install bracket

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supports in position, so that plaque is correctly located and aligned.

4. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of plaque and of suitable quantity to support weight of plaque after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as plaque is applied and to prevent visibility of cured adhesive at plaque edges. Place plaque in position, and push to engage adhesive. Temporarily support plaque in position until adhesive fully sets.
5. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of plaque and of suitable quantity to support weight of plaque without slippage. Keep strips away from edges to prevent visibility at plaque edges. Place plaque in position, and push to engage tape adhesive.
6. Shim-Plate Mounting: Provide 1/8-inch- thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other direct mounting methods are impractical. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach plaques to plate using [method specified above]<Insert requirement>.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed plaques and plaques that do not comply with specified requirements. Replace plaques with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as plaques are installed.

C. On completion of installation, clean exposed surfaces of plaques according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain plaques in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101416

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SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Dimensional characters.

a. Cast dimensional characters.
b. Cutout dimensional characters.
c. Fabricated channel dimensional characters.
d. Illuminated, fabricated channel dimensional characters.
e. Molded-plastic dimensional characters.
f. Illuminated, molded-plastic dimensional characters.

1.2 ALLOWANCES

A. Allowances for [signage][dimensional letter signs][illuminated, fabricated channel dimensional characters]<Insert item description> are specified in Section 012100 "Allowances."

B. <Insert product or material>[is][are] part of <Insert name of allowance>.

1.3 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.4 DEFINITIONS

A. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

1.5 COORDINATION

A. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For signs.

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1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign at least [half size]<Insert scale>.
4. Show locations of electrical service connections.
5. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Dimensional Characters: [Full-size Sample][Half-size Sample]<Insert size> of [each type of] dimensional character.
2. Exposed Accessories: [Full-size Sample][Half-size Sample]<Insert size> of each accessory type.
3. Full-size Samples, if approved, will be returned to Contractor for use in the Project.

E. Product Schedule: For dimensional letter signs. Use same designations indicated on Drawings or specified.

F. Delegated Design Submittal: For [signs indicated in "Performance Requirements" Article]<Insert sign designations>.

1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For [Installer][and][manufacturer].

B. Sample Warranty: For special warranty.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: [Manufacturer of products][An entity that employs installers and supervisors who are trained and approved by manufacturer].

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1.10 FIELD CONDITIONS

A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering.
b. Separation or delamination of sheet materials and components.

2. Warranty Period: [Five]<Insert number> 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 sign structure and anchorage of [rooftop][dimensional character]<Insert description> sign type(s) <Insert drawing designation of sign(s)> according to structural performance requirements.

B. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.

1. Uniform Wind Load: [As indicated on Drawings]<Insert design load>.
2. Concentrated Horizontal Load: [As indicated on Drawings]<Insert design load>.
3. Other Design Load: [As indicated on Drawings]<Insert design load>
4. Uniform and concentrated loads need not be assumed to act concurrently.

C. Thermal Movements: For exterior [fabricated channel dimensional characters]<Insert item>, allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: [120 deg F, ambient; 180 deg F, material surfaces]<Insert temperature change>.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

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2.2 DIMENSIONAL CHARACTERS

A. Cast Characters: Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. ASI Sign Systems, Inc
b. Gemini Signage; Gemini, Inc.
c. Matthews International Corporation; Bronze Division

2. Character Material: Cast aluminum.
3. Character Height: As indicated on Drawings.
4. Thickness: As indicated on Drawings.
5. Finishes:

a. Integral Metal Finish: As selected by Architect from full range of industry finishes.
b. Integral Aluminum Finish: Anodized color as selected by Architect from full range of industry colors and color densities.
c. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.
d. Overcoat: Manufacturer's standard baked-on clear coating.

6. Mounting: As indicated on Drawings.
7. Typeface: As indicated on drawings.

2.3 DIMENSIONAL CHARACTER MATERIALS

A. Aluminum Castings: ASTM B26/B26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.

B. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Aluminum Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

D. Brass Castings: ASTM B584, [alloy recommended by manufacturer and finisher for finish indicated][lead-free alloy recommended by manufacturer and finisher for finish indicated][Alloy UNS No. C85200 (high-copper yellow brass)]<Insert requirement>.

E. Brass Sheet (Yellow Brass): ASTM B36/B36M, [alloy recommended by manufacturer and finisher for finish indicated][lead-free alloy recommended by manufacturer and finisher for finish indicated][Alloy UNS No. C26000 (yellow brass)]<Insert requirement>.

F. Bronze Castings: ASTM B584, [alloy recommended by manufacturer and finisher for

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finish indicated][lead-free alloy recommended by manufacturer and finisher for finish indicated][Alloy UNS No. C86500 (No. 1 manganese bronze)]<Insert requirement>.

G. Bronze Plate: ASTM B36/B36M, [alloy recommended by manufacturer and finisher for finish indicated][lead-free alloy recommended by manufacturer and finisher for finish indicated][Alloy UNS No. C22000 (commercial bronze)]<Insert requirement>.

H. Copper Sheet: ASTM B152/B152M.

I. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, [Type 304,][Type 316,] stretcher-leveled standard of flatness.

J. Zinc Castings: ASTM B240, alloy and temper recommended by sign manufacturer for type of use and finish indicated.

K. Zinc Sheet: [ASTM B69]<Insert standard>, alloy and temper recommended by sign manufacturer for type of use and finish indicated.

L. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

M. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish [nonferrous-metal][stainless steel][or][hot-dip galvanized]<Insert requirement> devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

    a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
    b. Fastener Heads: For nonstructural connections, use [flathead][or][oval countersunk]<Insert shape> screws and bolts with tamper-resistant [Allen-head][spanner-head][or][one-way-head]<Insert slot design> slots unless otherwise indicated.

4. Sign Mounting Fasteners:

    a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
    b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to

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back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.

c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.

B. Adhesive: As recommended by sign manufacturer.

C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
5. Internally brace dimensional characters for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
6. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish [to match sign-background color][to match Architect's sample]<Insert requirement> color unless otherwise indicated.
2. Stainless Steel Brackets: Factory finish brackets [to match sign background][to

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match Architect's sample][with No. 4]<Insert finish> finish unless otherwise indicated.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, [Class I, 0.018 mm][Class II, 0.010 mm] or thicker.

B. Color Anodic Finish: AAMA 611, [Class I, 0.018 mm][Class II, 0.010 mm] or thicker.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

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.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Verify that electrical service is correctly sized and located to accommodate signs.

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

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3.2 INSTALLATION OF DIMENSIONAL CHARACTERS

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.

3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
4. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position, so that signage is correctly located and aligned.
5. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive

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fully sets.

6. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

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SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes room-identification signs that are directly attached to the building.

B. Related Requirements:

1. Section 101300 "Directories" for building directories.
2. Section 101416 "Plaques" for one-piece, solid metal signs, with or without frames, that are used for high-end room-identification.

1.2 ALLOWANCES

A. Allowances for [signage][room-identification signs]<Insert item description> are specified in Section 012100 "Allowances."

B. <Insert product or material>[is][are] part of <Insert name of allowance>.

1.3 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.4 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.5 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For room-identification signs.

1. Include fabrication and installation details and attachments to other work.

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2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements [, including raised characters and Braille], and layout for each sign at least [half size]<Insert scale>.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Room-Identification Signs: [Full-size Sample]<Insert size>.
2. Variable Component Materials: [Full-size Sample][8-inch Sample]<Insert size> of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
3. Exposed Accessories: [Full-size Sample][Half-size Sample]<Insert size> of each accessory type.
4. Full-size Samples, if approved, will be returned to Contractor for use in Project.

E. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For [Installer][and][manufacturer].

B. Sample Warranty: For special warranty.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.9 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials [, from the same product run,] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Variable Component Materials: [12]<Insert number> replaceable text inserts and interchangeable characters (letters, numbers, and graphic elements) of each type.
2. Tools: [One]<Insert number> set(s) of specialty tools for assembling signs and replacing variable sign components.

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1.10 QUALITY ASSURANCE

A. Installer Qualifications: [Manufacturer of products][An entity that employs installers and supervisors who are trained and approved by manufacturer].

1.11 FIELD CONDITIONS

A. Field Measurements: Verify locations of [anchorage devices][and][electrical service] embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.12 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering.
b. Deterioration of embedded graphic image.
c. Separation or delamination of sheet materials and components.

2. Warranty Period: [Five]<Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in [the USDOJ's "2010 ADA Standards for Accessible Design"][the ABA standards of the Federal agency having jurisdiction][and][ICC A117.1]<Insert requirement>.

2.2 ROOM-IDENTIFICATION SIGNS

A. Room-Identification Sign: [Sign][Sign system] with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. ACE Sign Systems, Inc.
b. ASI Sign Systems, Inc

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c. Mohawk Sign Systems
d. Signs & Decal Corp

2. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated [over subsurface graphics] to acrylic backing sheet to produce composite sheet.

a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
b. Subsurface Graphics: Slide-in changeable insert.
c. Color(s): As selected by Architect from manufacturer's full range.

3. Sign-Panel Perimeter: Finish edges smooth.

a. Edge Condition [at Vertical Edges][at Horizontal Edges]: As indicated on Drawings.
b. Corner Condition in Elevation: As indicated on Drawings.

4. Frame: Entire perimeter.

a. Material: [Aluminum]<Insert material>.
b. Material Thickness: <Insert dimension>.
c. Frame Depth: [As indicated on Drawings][Convex-curved frame to receive removable face sheet and changeable subsurface graphics]<Insert dimension>.
d. Profile: Square.
e. Corner Condition in Elevation: Square.
f. Finish and Color: As selected by Architect from manufacturer's full range.

5. Mounting: Manufacturer's standard method for substrates indicated with [concealed anchors][countersunk flathead through fasteners][adhesive][two-face tape][hook-and-loop tape][or][magnetic tape].
6. Text and Typeface: Accessible raised characters and Braille. Finish raised characters to contrast with background color, and finish Braille to match background color.

2.3 SIGN MATERIALS

A. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

B. Aluminum Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

D. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings [and suitable for exterior applications].

E. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended

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by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish [nonferrous-metal][stainless-steel][or][hot-dip galvanized]<Insert requirement> devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

    a. Fabricated from same basic metal and finish of fastened sign unless otherwise indicated.
    b. Fastener Heads: Use [flathead][or][oval countersunk]<Insert shape> screws and bolts with tamper-resistant [Allen-head][spanner-head][or][one-way-head]<Insert slot design> slots unless otherwise indicated.

4. Sign Mounting Fasteners:

    a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
    b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.

B. Adhesive: As recommended by sign manufacturer.

C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

D. Hook-and-Loop Tape: Manufacturer's standard two-part tape consisting of hooked part on sign back and looped side on mounting surface.

E. Magnetic Tape: Manufacturer's standard magnetic tape with adhesive on one side.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.

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3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.

C. Subsurface-Etched Graphics: Reverse etch back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.

D. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:

1. For snap-in changeable inserts beneath removable face sheet, furnish one suction or other device to assist in removing face sheet. Furnish initial changeable insert. [Subsequent changeable inserts are by Owner][Furnish two blank inserts for each sign for Owner's use]<Insert requirement>.
2. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. [Subsequent changeable inserts are by Owner][Furnish two blank inserts for each sign for Owner's use]<Insert requirement>.
3. For frame to hold changeable sign panel, fabricate frame without burrs or constrictions that inhibit function. Furnish initial sign panel. [Subsequent changeable sign panels are by Owner]<Insert requirement>.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, [Class I, 0.018 mm][Class II, 0.010 mm] or thicker.

B. Color Anodic Finish: AAMA 611, [Class I, 0.018 mm][Class II, 0.010 mm] or thicker.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

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PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

B. Accessibility: Install signs in locations on walls [as indicated on Drawings][and][according to the accessibility standard]<Insert requirement>.

C. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

    a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
    b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
3. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
4. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
5. Hook-and-Loop Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply sign component of two-part tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage; push to engage tape adhesive. Keep tape strips [0.250 inch]<Insert dimension> away from edges to prevent visibility at sign edges when sign is initially installed

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or reinstalled. Apply substrate component of tape to substrate in locations aligning with tape on back of sign; push and rub well to fully engage tape adhesive to substrate.

6. Magnetic Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position.

3.2 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101423.16

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SECTION 102113.19 - PLASTIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-plastic toilet compartments.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for supports that attach [ceiling-hung compartments][floor-and-ceiling-anchored compartments][and][post-to-ceiling screens] to overhead structural system.
2. Section 061000 "Rough Carpentry" for [blocking][overhead support of floor-and-ceiling-anchored compartments][and][overhead support of post-to-ceiling screens].
3. Section 092216 "Non-Structural Metal Framing" for blocking.
4. Section 102800 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.

1.2 COORDINATION

A. Coordinate requirements for [overhead supports,] blocking, reinforcing, and other supports concealed within wall [and ceiling] to ensure that toilet compartments can be supported and installed as indicated.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Solid-plastic toilet compartments:

a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachment details.
2. Show locations of cutouts for compartment-mounted toilet accessories.
3. Show locations of centerlines of toilet fixtures.
4. Show locations of floor drains.
5. Show [ceiling grid, ceiling-mounted items, and] overhead support or bracing locations.
6. <Insert requirements>.

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C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of toilet compartment.

1. Include Samples of hardware and accessories involving material and color selection.

D. Samples for Verification: Actual sample of finished products for each type of toilet compartment, hardware, and accessory.

1. Size: [Manufacturer's standard size]<Insert size>.

E. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

F. Delegated Design Submittals: For grab bars mounted on toilet compartment panels, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Include structural design calculations indicating compliance with specified structural-performance requirements.

G. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party Certified Life Cycle Assessment: For each product.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For toilet compartments.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Materials: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Door Hinges: [One]<Insert number> hinge(s) with associated fasteners.
2. Latch and Keeper: [One]<Insert number> latch(es) and keeper(s) with associated fasteners.
3. Door Bumper: [One]<Insert number> bumper(s) with associated fasteners.
4. Door Pull: [One]<Insert number> door pull(s) with associated fasteners.
5. Fasteners: [10]<Insert number> fasteners of each size and type.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements, and coordinate before fabrication.

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PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain plastic toilet compartments from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert value> percent.

B. Fire Performance: Tested in accordance with, and pass the acceptance criteria of, NFPA 286.

C. Structural Performance: Where grab bars are mounted on toilet compartments, design panels to comply with the following requirements:

1. Panels are able to withstand a concentrated load on grab bar of at least 250 lbf applied at any direction and at any point, without deformation of panel.

D. Regulatory Requirements: Comply with applicable provisions in [the USDOJ's "2010 ADA Standards for Accessible Design"][and][ICC A117.1]<Insert accessibility regulation> for toilet compartments designated as accessible.

2.3 SOLID-PLASTIC TOILET COMPARTMENTS

A. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

1. American Sanitary Partition Corporation
2. Hadrian Inc.; Zurn Industries, LLC
3. Scranton Products

B. Toilet-Enclosure Style: Overhead braced.

C. Entrance-Screen Style: Overhead braced.

D. Urinal-Screen Style: Wall hung.

E. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color throughout thickness of material. [Provide with no-sightline system consisting of door and pilaster lapped edges on strike side of door and door and pilaster lapped edges on hinge side of door (unless continuous hinge is used).]

1. Integral Hinges: Configure doors and pilasters to receive integral hinges.

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2. Heat-Sink Strip: Manufacturer's continuous, extruded-aluminum strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
3. Color: [One color][Two colors] in each room as selected by Architect from manufacturer's full range.

F. Entrance-Screen Construction: Matching panel construction.

G. Urinal-Screen Construction: Matching panel construction.

H. Pilaster Shoes: Manufacturer's standard design; solid plastic.

1. Plastic Color: Contrasting with pilaster, as selected by Architect from manufacturer's full range.

I. Pilaster Sleeves (Caps): Manufacturer's standard design; solid plastic.

1. Plastic Color: Contrasting with pilaster, as selected by Architect from manufacturer's full range.

J. Urinal-Screen Post: Manufacturer's standard post design of material matching the thickness and construction of pilasters; with shoe [and sleeve (cap)] matching that on the pilaster.

K. Brackets (Fittings):

1. Stirrup Type: Ear or U-brackets, aluminum.
2. Full-Height (Continuous) Type: Manufacturer's standard design; solid plastic or extruded aluminum.

a. Plastic Color: Contrasting with panel, as selected by Architect from manufacturer's full range.

L. Overhead Cross Bracing for Ceiling-Hung Units: As recommended by manufacturer and fabricated from solid plastic.

2.4 HARDWARE AND ACCESSORIES

A. Door Hardware and Accessories: Manufacturer's operating hardware and accessories. [Mount with through bolts.]

1. Hinges:

a. Manufacturer's paired, wraparound, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door.

1) Material, Paired Hinge: Aluminum.

b. Manufacturer's [continuous, cam type that swings to a closed or partially

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open position][continuous, spring-loaded type], allowing emergency access by lifting door.

1) Material, Continuous Hinge: [Aluminum][Stainless steel][Manufacturer's standard].

c. Manufacturer's integral hinge for solid-plastic doors, allowing emergency access by lifting door.

1) Material, Integral Hinge: Nylon gravity cam unit with stainless steel pins/screws.

d. Manufacturer's standard hinge.
e. <Insert requirement>.

2. Latch and Keeper: Manufacturer's surface-mounted latch unit, designed for emergency access, and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at toilet enclosures designated as accessible.

a. Material: Chrome-plated zamac.

3. Coat Hook: Manufacturer's combination hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories.

a. Material: Chrome-plated zamac.

4. Door Bumper: Manufacturer's rubber-tipped bumper at outswinging doors.

a. Material: Chrome-plated zamac.

5. Door Pull: Manufacturer's unit at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at toilet enclosures designated as accessible.

a. Material: Chrome-plated zamac.

B. Door Hardware and Accessories, Heavy Duty: Manufacturer's heavy-duty institutional operating hardware and accessories.

1. Hinges: Manufacturer's minimum 0.062-inch- thick, stainless steel [paired, wraparound, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees][continuous, cam type that swings to a closed or partially open position][continuous, spring-loaded type]<Insert requirement>, allowing emergency access by lifting door. Mount with through bolts.
2. Latch and Keeper: Manufacturer's heavy-duty, surface-mounted, cast stainless steel latch unit, designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at toilet enclosures designated as accessible. Mount with through bolts.
3. Coat Hook: Manufacturer's heavy-duty, combination cast stainless steel hook

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and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories. Mount with through bolts.

4. Door Bumper: Manufacturer's heavy-duty, rubber-tipped, cast stainless steel bumper at outswinging doors. Mount with through bolts.
5. Door Pull: Manufacturer's heavy-duty, cast stainless steel pull at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at toilet enclosures designated as accessible. Mount with through bolts.

C. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

D. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.5 MATERIALS

A. Aluminum Castings: ASTM B26/B26M.

B. Aluminum Extrusions: ASTM B221.

C. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.

D. Stainless Steel Castings: ASTM A743/A743M.

E. Zamac: ASTM B86, commercial zinc-alloy die castings.

2.6 FABRICATION

A. Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Overhead-Braced Units: Manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Floor-Anchored Units: Manufacturer's standard corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

D. Ceiling-Hung Units: Manufacturer's standard corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at

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tops of pilasters to conceal anchorage.

E. Floor-and-Ceiling-Anchored Units: Manufacturer's standard corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment nuts at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

F. Urinal-Screen Posts: Manufacturer's standard corrosion-resistant anchoring assemblies at posts and walls, with leveling adjustment nuts at [tops and] bottoms of posts. Provide shoes [and sleeves (caps)] at posts to conceal anchorage.

G. Door Size and Swings: Unless otherwise indicated, provide 24-inch- wide, inswinging doors for standard toilet enclosures and 36-inch- wide, outswinging doors with a minimum 32-inch- wide, clear opening for toilet enclosures designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.

1. Confirm location and adequacy of blocking and supports required for installation.

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

3.2 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels or Screens: 1/2 inch.
b. Panels or Screens and Walls: 1 inch.

2. Stirrup Brackets: Secure panels or screens to walls and to pilasters with no fewer than [two brackets attached][three brackets attached at midpoint and] near top and bottom of panel or screen.

a. Locate wall brackets, so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

3. Full-Height (Continuous) Brackets: Secure panels or screens to walls and to pilasters with full-height brackets.

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a. Locate bracket fasteners, so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels and adjust, so tops of doors are parallel with overhead brace when doors are in closed position.

C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust, so tops of doors are level with tops of pilasters when doors are in closed position.

D. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust, so bottoms of doors are level with bottoms of pilasters when doors are in closed position.

E. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust, so doors are level and aligned with panels, when doors are in closed position.

F. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware in accordance with hardware manufacturer's written instructions for proper operation. Set hinges on inswinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on outswinging doors to return doors to fully closed position.

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SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall guards.
2. Corner guards.

B. Related Requirements:

1. Section 064023 "Interior Architectural Woodwork for solid-wood handrails, bumper rails, chair rails, or corner moldings without plastic bumpers.
2. Section 087100 "Door Hardware" for metal and plastic protective trim units, according to BHMA A156.6, used for armor, kick, mop, and push plates.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
2. Include fire ratings of units recessed in fire-rated walls and listings for door-protection items attached to fire-rated doors.

B. Shop Drawings: For each type of wall and door protection showing locations and extent.

1. Include plans, elevations, sections, and attachment details. Show handrail design and support spacing required to withstand structural loads.

C. Samples for Initial Selection: For each type of impact-resistant wall-protection unit indicated, in each color and texture specified.

1. Include Samples of accent strips and accessories to verify color selection.

D. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:

1. Wall Guards: 12 inches long. Include examples of joinery, corners, [end caps,][top caps,] and field splices.
2. Corner and End-Wall Guards: 12 inches long. Include example top caps.

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1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of handrail.

B. Material Certificates: For each type of exposed plastic material.

C. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.

1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials , from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Wall-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of cover installed, but no fewer than two, 96-inch- long units.
2. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of cover installed, but no fewer than two, 48-inch- long units.
3. Mounting and Accessory Components: Amounts proportional to the quantities of extra materials. Package mounting and accessory components with each extra material.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
2. Keep plastic materials out of direct sunlight.
3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.

a. Store corner-guard covers in a vertical position.
b. Store wall-guard covers in a horizontal position.

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1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.

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

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain wall- and door-protection products of each type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

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

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

2.3 WALL GUARDS

A. Bumper Rail: Standard-duty , PVC-free assembly consisting of continuous snap-on plastic cover installed over concealed retainer; designed to withstand impacts.

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

a. Babcock-Davis
b. Koroseal Interior Products, LLC

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c. Pawling Corporation

2. Cover: Extruded rigid plastic, minimum 0.078-inch wall thickness; as follows:

a. Profile: Flat profile, nominal 4 inches high by 1 inch deep.
b. Color and Texture: As selected by Architect from manufacturer's full range.

3. Retainer Clips: Manufacturer's standard impact-absorbing clips.
4. Bumper: Continuous, resilient bumper cushion(s).
5. End Caps and Corners: Prefabricated, injection-molded plastic; matching color cover; field adjustable for close alignment with snap-on cover.
6. Accessories: Concealed splices and mounting hardware.
7. Mounting: Surface mounted directly to wall.

2.4 CORNER GUARDS

A. Flush-Mounted, Plastic-Cover Corner Guards: Manufacturer's standard , PVC-free assembly consisting of snap-on, resilient plastic cover that is flush with adjacent wall surface, installed over retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition; full wall height.

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. Construction Specialties, Inc.
b. Koroseal Interior Products, LLC
c. Pawling Corporation

2. Cover: Extruded rigid plastic, minimum 0.078-inch wall thickness; [as follows:][in dimensions and profiles indicated on Drawings.]

a. Profile: Nominal 3-inch- long leg and 1/4-inch corner radius.
b. Height: 4 feet.
c. Color and Texture: As selected by Architect from manufacturer's full range.

3. Retainer Clips: Manufacturer's standard impact-absorbing clips.
4. Aluminum Cove Base: Nominal 4 inches high.

2.5 MATERIALS

A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.

B. Polycarbonate Plastic Sheet: ASTM D6098, S-PC01, Class 1 or Class 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft.-lbf/in. of notch when tested according to ASTM D256, Test Method A.

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C. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

D. Adhesive: As recommended by protection product manufacturer.

2.6 FABRICATION

A. Fabricate wall protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.

B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.7 FINISHES

A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances , fire rating, and other conditions affecting performance of the Work.

B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

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

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3.2 PREPARATION

A. Complete finishing operations, including painting, before installing wall and door protection.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings. If not indicated on Drawings, install at heights indicated below:

1. Bumper Rails: 12" above finished floor.

C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.

1. Provide anchoring devices and suitable locations to withstand imposed loads.
2. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches apart.
3. Adjust end and top caps as required to ensure tight seams.

D. Door-Frame Protectors: Install on both door jams.

E. Fire Doors: Install protection according to the listing of each item.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

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SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Public-use shower room accessories.
3. Childcare accessories.
4. Custodial accessories.

B. Related Requirements:

1. Section 088300 "Mirrors" for frameless mirrors.
2. Section 093013 "Ceramic Tiling" for ceramic toilet and bath accessories.
3. Section 102813.63 "Detention Toilet Accessories" for accessories designed for installation in detention facilities.

1.2 ALLOWANCES

A. See Section 012100 "Allowances" for description of allowances affecting items specified in this Section.

1.3 UNIT PRICES

A. See Section 012200 "Unit Prices" for description of unit prices affecting items specified in this Section.

1.4 ALTERNATES

A. See Section 012300 "Alternates" for description of alternates affecting items specified in this Section.

1.5 COORDINATION

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

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

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1.6 ACTION SUBMITTALS

A. Product Data: For each product.

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

B. Samples: For each exposed product and for each finish specified, full size.

1. Approved full-size Samples will be returned and may be used in the Work.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify accessories using designations indicated.

D. Delegated Design Submittals: For [grab bars][and][shower seats].

1. Include structural design calculations indicating compliance with specified structural-performance requirements.

1.7 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranties.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

1.9 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, visible silver spoilage defects.
2. Warranty Period: [10][15]<Insert number> years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Toilet-Compartment Occupancy-Indicator Systems: Manufacturer agrees to repair or replace toilet-compartment occupancy-indicator systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: [Five]<Insert number> years from date of Substantial Completion.

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C. Manufacturer's Special Warranty for Hand Dryers: Manufacturer agrees to repair or replace hand dryers that fail in materials or workmanship within specified warranty period.

1. Warranty Period: [Two][Five][10]<Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED MATERIALS

A. Owner-Furnished Materials: <Insert products>.

2.2 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Structural Performance: Design accessories and fasteners to comply with the following requirements:

1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.
2. Shower Seats: Installed units are able to resist [250 lbf][360 lbf]<Insert load> concentrated load applied in any direction and at any point.

2.3 PUBLIC-USE WASHROOM ACCESSORIES

A. Source Limitations: Obtain [public-use washroom accessories][each type of public-use washroom accessory] from single source from single manufacturer.

B. Toilet Tissue (Roll) Dispenser:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. ASI-American Specialties, Inc.
b. Bobrick Washroom Equipment, Inc
c. Bradley Corporation

2. Description: Double-roll dispenser.
3. Mounting: Surface mounted.
4. Operation: Noncontrol delivery with standard spindle.
5. Capacity: Designed for 4-1/2- or 5-inch- diameter tissue rolls.

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6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

C. Paper Towel (Roll) Dispenser:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. ASI-American Specialties, Inc.
    b. Bobrick Washroom Equipment, Inc
    c. Bradley Corporation

2. Description: Lever-actuated mechanism that permits controlled delivery of paper rolls in preset lengths.
3. Mounting: Surface mounted.
4. Minimum Capacity: 8-inch- wide, 800-foot- long roll.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
6. Lockset: Tumbler type.

D. Combination Towel (Folded) Dispenser/Waste Receptacle:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. ASI-American Specialties, Inc.
    b. Bobrick Washroom Equipment, Inc
    c. Bradley Corporation

2. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
3. Mounting: Recessed.

    a. Designed for nominal 4-inch wall depth.

4. Minimum Towel-Dispenser Capacity: [600 C-fold or 800 multifold paper towels]<Insert capacity>.
5. Minimum Waste-Receptacle Capacity: 12 gal..
6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
7. Liner: [Reusable, vinyl waste-receptacle liner]<Insert liner description>.
8. Lockset: Tumbler type for towel-dispenser compartment [and waste receptacle].

E. Soap Dispenser:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

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a. ASI-American Specialties, Inc.
b. Bobrick Washroom Equipment, Inc
c. Bradley Corporation

2. Description: Designed for manual operation and dispensing soap in [liquid or lotion][lather] form.
3. Mounting: Vertically oriented, surface mounted.
4. Capacity: <Insert value>.
5. Materials: <Insert requirements>.
6. Lockset: Tumbler type.
7. Refill Indicator: Window type.

F. Sanitary-Napkin and Tampon Vendor:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. ASI-American Specialties, Inc.
b. Bobrick Washroom Equipment, Inc
c. Bradley Corporation

2. Mounting: Surface mounted.
3. Capacity: <Insert description>.
4. Operation: No coin (free).
5. Exposed Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
6. Lockset: Tumbler type with separate lock and key for coin box.

G. Sanitary-Napkin Disposal Unit:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. ASI-American Specialties, Inc.
b. Bobrick Washroom Equipment, Inc
c. Bradley Corporation

2. Mounting: Surface mounted.
3. Door or Cover: Self-closing, disposal-opening cover [and hinged face panel with tumbler lockset].
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

H. Mirror Unit:

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

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offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. ASI-American Specialties, Inc.
b. Bobrick Washroom Equipment, Inc
c. Bradley Corporation

2. Frame: Stainless steel, fixed tilt.

a. Corners: Manufacturer's standard.

3. Size: [As indicated on Drawings]<Insert dimensions>.
4. Hangers: [Manufacturer's standard rigid, tamper and theft resistant]<Insert requirements>.

I. Hook:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. ASI-American Specialties, Inc.
b. Bobrick Washroom Equipment, Inc
c. Bradley Corporation

2. Description: Double-prong unit Single-prong unit.
3. Mounting: Concealed.
4. Material and Finish: Polished chrome-plated brass.

2.4 PUBLIC-USE SHOWER ROOM ACCESSORIES

A. Source Limitations: Obtain [public-use shower room accessories][each type of public-use shower room accessory] from single source from single manufacturer.

B. Shower Curtain Rod:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. ASI-American Specialties, Inc.
b. Bobrick Washroom Equipment, Inc
c. Bradley Corporation

2. Description: 1-1/4-inch- OD, straight rod.
3. Configuration: As indicated on Drawings.
4. Mounting Flanges: Exposed fasteners; in manufacturer's standard material and finish.

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5. Rod Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

C. Folding Shower Seat:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. ASI-American Specialties, Inc.
    b. Bobrick Washroom Equipment, Inc
    c. Bradley Corporation

2. Configuration: L-shaped seat, designed for wheelchair access.
3. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Architect.
4. Mounting Mechanism: [Stainless steel, ASTM A480/A480M No. 4 finish (satin)]<Insert description>.
5. Dimensions: <Insert dimensions>.

2.5 CHILDCARE ACCESSORIES

A. Source Limitations: Obtain [childcare accessories][each type of childcare accessory] from single source from single manufacturer.

B. Diaper-Changing Station:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. ASI-American Specialties, Inc.
    b. Bradley Corporation
    c. Koala Kare Products; Bobrick Washroom Equipment, Inc.

2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.

    a. Engineered to support minimum of [250 lb]<Insert value> static load when opened.

3. Mounting: Surface mounted, with unit projecting not more than 4 inches from wall when closed.
4. Operation: By pneumatic shock-absorbing mechanism.
5. Material and Finish: HDPE in manufacturer's standard color.
6. Liner Dispenser: Provide [built-in][separate, locking] dispenser for disposable sanitary liners.

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2.6 CUSTODIAL ACCESSORIES

A. Source Limitations: Obtain [custodial accessories][each type of custodial accessory] from single source from single manufacturer.

B. Custodial Utility Shelf:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. ASI-American Specialties, Inc.
    b. Bobrick Washroom Equipment, Inc
    c. Bradley Corporation

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

C. Custodial Mop and Broom Holder:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. ASI-American Specialties, Inc.
    b. Bobrick Washroom Equipment, Inc
    c. Bradley Corporation

2. Description: [Unit with shelf, hooks, holders, and rod suspended beneath shelf]<Insert description>.
3. Length: [36 inches]<Insert dimension>.
4. Hooks: [Four]<Insert number>.
5. Mop/Broom Holders: [Three]<Insert number>, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

    a. Rod: Approximately 1/4-inch- diameter stainless steel.

2.7 HAND-SANITIZER DISPENSERS

A. Source Limitations: Obtain [hand-sanitizer dispensers][each type of hand-sanitizer dispenser] from single source from single manufacturer.

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2.8 MATERIALS

A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch- minimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings.

C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch- minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 hot-dip zinc coating.

E. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.

F. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.

G. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).

H. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.9 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of [six]<Insert number> keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION OF TOILET, BATH, AND LAUNDRY ACCESSORIES

A. Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

1. Remove temporary labels and protective coatings.

B. Grab Bars: Install to comply with specified structural-performance requirements.

C. Shower Seats: Install to comply with specified structural-performance requirements.

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3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION 102800

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SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinet.

B. Related Requirements:

1. Section 104416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets.
2. Section 211000 "Water-Based Fire-Suppression Systems" for fire-hose connections.

1.2 ALLOWANCES

A. Fire-protection cabinets are part of <Insert name of allowance>.

1.3 UNIT PRICES

A. Work of this Section is affected by <Insert name of unit price>.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference [at Project site][by web conference]<Insert location>.

1. Review methods and procedures related to fire-protection cabinets, including, but not limited to, the following:

a. Schedules and coordination requirements.

1.5 ACTION SUBMITTALS

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

1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
2. Show location of knockouts for hose valves.

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B. Shop Drawings: For fire-protection cabinets.

1. Include plans, elevations, sections, and attachment details.

C. Samples for Initial Selection: For each type of exposed finish required.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples 6 by 6 inches square.

E. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function. [Use same designations indicated on Drawings.]

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets.

1.7 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of [fire extinguishers][fire hoses, hose valves, and hose racks] indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

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.

2.3 FIRE-PROTECTION CABINETS

A. Fire-Protection Cabinet:

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1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. Babcock-Davis
    b. JL Industries; Activar Construction Products Group, Inc.
    c. Larsen's Manufacturing Company

2. Fire-Protection Cabinet Type: Suitable for fire extinguisher.
3. Cabinet Construction: Nonrated.

    a. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch- thick cold-rolled steel sheet lined with minimum 5/8-inch- thick fire-barrier material. Provide factory-drilled mounting holes.

4. Cabinet Material: Stainless steel sheet.

    a. Shelf: Same metal and finish as cabinet.

5. Recessed Cabinet:

    a. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box, to act as [plaster stop][drywall bead].
    b. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.
    c. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

6. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

    a. Square-Edge Trim: 1-1/4- to 1-1/2-inch backbend depth.
    b. Rolled-Edge Trim: 2-1/2-inch backbend depth.

7. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.
8. Cabinet Trim Material: Stainless steel sheet.
9. Door Material: Stainless steel sheet.
10. Door Style: Fully glazed panel with frame.
11. Door Glazing: Tempered float glass (clear).

    a. Acrylic Sheet Color:

        1) [Clear][Bronze] transparent acrylic sheet.
        2) Clear transparent acrylic sheet painted red on unexposed side.

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b. Acrylic Bubble Color: [Clear][Bronze][Red], transparent.

12. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

    a. Provide recessed door pull and friction latch.
    b. Provide continuous hinge, of same material and finish as trim, manufacturer's standard hinge, permitting door to open 180 degrees.

13. Accessories:

    a. 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.
    b. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
    c. Break-Glass Door Handle: Manufacturer's standard, integral to glass with the words "PULL TO BREAK GLASS" applied to handle.
    d. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
    e. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
    f. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate [as indicated][as directed by Architect]<Insert location>.

        1) Identify fire extinguisher in fire-protection cabinet with the words "[FIRE EXTINGUISHER]<Insert identification>."

            a) Location: Applied to cabinet glazing.
            b) Application Process: Pressure-sensitive vinyl letters.
            c) Lettering Color: Red.
            d) Orientation: As indicated on Drawings.

    g. Alarm: Manufacturer's standard alarm that actuates when fire-protection cabinet door is opened and that is powered by batteries.

14. Materials:

    a. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.

        1) Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
        2) Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
        3) Color: As selected by Architect from manufacturer's full range.

    b. Aluminum: ASTM B221 for extruded shapes and aluminum sheet, with strength and durability characteristics of not less than Alloy 6063-T5 for

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aluminum sheet.

1) Finish: Baked enamel or powder coat.
2) Color: As selected by Architect from full range of industry colors and color densities.

c. Clear Float Glass: ASTM C1036, Type I, Class 1, Quality q3, 6 mm thick.
d. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).
e. Break Glass: Clear annealed float glass, ASTM C1036, Type I, Class 1, Quality q3, 1.5 mm thick, single strength.
f. Tempered Break Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.
g. Wire Glass: ASTM C1036, Type II, Class 1, Form 1, Quality q8, Mesh m1 (diamond), 6 mm thick.
h. Transparent Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet), 6 mm thick, with Finish 1 (smooth or polished).

2.4 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. Miter corners and grind smooth.
3. Provide factory-drilled mounting holes.
4. Prepare doors and frames to receive locks.
5. 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.

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 and grind smooth.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM AMP 500for 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.

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D. Appearance of Finished Work: 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for hose [valves][racks] and cabinets to verify actual locations of piping connections before cabinet installation.

B. Examine walls and partitions for suitable framing depth and blocking where [recessed][and][semirecessed] cabinets will be installed.

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

3.2 PREPARATION

A. Prepare recesses for [recessed][and][semirecessed] fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION OF FIRE-PROTECTION CABINETS

A. General: Install fire-protection cabinets in locations and at mounting heights indicated [or, if not indicated, at height indicated below:][or, if not indicated, at heights acceptable to authorities having jurisdiction.]

1. Fire-Protection Cabinet Mounting Height: [42 inches][As indicated on Drawings]<Insert dimension> 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 inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
4. Fire-Rated Cabinets:

    a. Install cabinet with not more than 1/16-inch tolerance between pipe OD and knockout OD. Center pipe within knockout.
    b. Seal through penetrations with firestopping sealant as specified in Section 078413 "Penetration Firestopping."

C. Identification:

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1. Apply [decals][vinyl lettering] at locations indicated.
2. Apply [decals][vinyl lettering] on field-painted fire-protection cabinets after painting is complete.

3.4 ADJUSTING

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.

3.5 CLEANING

A. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

B. 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.

C. 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

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SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, [hand-carried][wheeled] fire extinguishers [and mounting brackets for fire extinguishers].

B. Owner-Furnished Material: [Hand-carried][Wheeled] fire extinguishers.

C. Related Requirements:

1. Section 104413 "Fire Protection Cabinets."
2. Section 233813 "Commercial-Kitchen Hoods" for fire-extinguishing systems provided as part of commercial-kitchen exhaust hoods.

1.2 ALLOWANCES

A. Fire Extinguishers are part of <Insert name of allowance>.

1.3 UNIT PRICES

A. Work of this Section is affected by <Insert name of unit price>.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]<Insert location>.

1. Review methods and procedures related to fire extinguishers including, but not limited to, the following:

a. Schedules and coordination requirements.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher [and mounting brackets].

B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. [Use same designations indicated on Drawings.]

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1.6 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.8 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.9 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 when testing interval required by NFPA 10 is within the warranty period.
b. Faulty operation of valves or release levers.

2. Warranty Period: [Six]<Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 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.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each [fire-protection cabinet][and][mounting bracket] indicated.

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1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. Ansul; brand of Johnson Controls International plc, Building Solutions North America
    b. Babcock-Davis
    c. JL Industries; Activar Construction Products Group, Inc.
    d. Kidde; Carrier Global Corporation
    e. Larsen's Manufacturing Company

2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
3. Valves: Manufacturer's standard.
4. Handles and Levers: Manufacturer's standard.
5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B [, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging].

B. Stored-Pressure Water Type : UL-rated 2-A, 2.5-gal. nominal capacity, with water in stainless steel container; with pressure-indicating gage.

C. Stored-Pressure Antifreeze Water Type : UL-rated 2-A, 2.5-gal. nominal capacity, with water and approved antifreeze solution mixed for temperatures as low as minus 40 deg F in stainless steel container; with pressure-indicating gage.

D. Stored-Pressure Water-Mist Type : UL-rated 2-A:C, 2.5-gal. nominal capacity, with water in enameled-steel container; with pressure-indicating gage.

E. Pressurized, AFFF-Foam Type : UL-rated 2-A:10-B, 1.6-gal. nominal capacity, with AFFF foam in stainless steel container; with pressure-indicating gage.

F. Pressurized, FFFP-Foam Type : UL-rated 3-A:20-B, 2.5-gal. nominal capacity, with FFFP foam in stainless steel container; with pressure-indicating gage.

G. Wet-Chemical Type : UL-rated 2-A:1-B:C:K, 2.5-gal. nominal capacity, with potassium acetate -based chemical in stainless steel container; with pressure-indicating gage.

H. Regular Dry-Chemical Type : UL-rated <Insert capacity> nominal capacity, with sodium bicarbonate-based dry chemical in manufacturer's standard enameled container.

I. Regular Dry-Chemical Type in Steel Container : UL-rated 10-B:C, 2.5-lb nominal capacity, with sodium bicarbonate-based dry chemical in enameled-steel container.

J. Regular Dry-Chemical Type in Aluminum Container : UL-rated 10-B:C, 2.5-lb nominal capacity, with sodium bicarbonate-based dry chemical in enameled-aluminum container.

K. Regular Dry-Chemical Type in Brass Container : UL-rated 40-B:C, 6-lb nominal capacity, with sodium bicarbonate-based dry chemical in chrome-plated-brass

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container.

L. Multipurpose Dry-Chemical Type : UL-rated <Insert capacity> nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

M. Multipurpose Dry-Chemical Type in Steel Container : UL-rated 2-A:10-B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

N. Multipurpose Dry-Chemical Type in Aluminum Container : UL-rated 2-A:10-B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-aluminum container.

O. Multipurpose Dry-Chemical Type in Brass Container : UL-rated 2-A:10-B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in chrome-plated-brass container.

P. Purple-K Dry-Chemical Type in Aluminum Container : UL-rated [10-B:C, 2.5-lb][30-B:C, 5-lb][120-B:C, 20-lb] nominal capacity, with potassium bicarbonate-based dry chemical in enameled-aluminum container.

Q. Purple-K Dry-Chemical Type in Brass Container : UL-rated 80-B:C, 10-lb nominal capacity, with potassium bicarbonate-based dry chemical in chrome-plated-brass container.

R. Carbon Dioxide Type : UL-rated 5-B:C, 5-lb nominal capacity, with carbon dioxide in manufacturer's standard enameled-metal container.

S. Dry-Powder Type : [FM approved,] UL-rated Class D, 30-lb nominal capacity, with [sodium chloride][copper] -based powder in enameled-steel container; with pressure-indicating gage.

T. Halon Type : 10-B:C, 5-lb nominal capacity, in enameled-steel container; with pressure-indicating gage.

1. UL-rated.

U. Clean-Agent Type in Aluminum Container : UL-rated 5-B:C, 5-lb nominal capacity, with HCFC Blend B agent and inert material in enameled-aluminum container; with pressure-indicating gage.

V. Clean-Agent Type in Brass Container : UL-rated 1-A:10-B:C, 11-lb nominal capacity, with HCFC Blend B agent and inert material in chrome-plated-brass container; with pressure-indicating gage.

W. Clean-Agent Type in Steel Container : UL-rated 5-B:C, 4.75-lb nominal capacity, with HFC blend agent and inert material in enameled-steel container; with pressure-indicating gage.

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2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard [galvanized] steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. Ansul; brand of Johnson Controls International plc, Building Solutions North America
b. Babcock-Davis
c. Kidde; Carrier Global Corporation
d. Larsen's Manufacturing Company

2. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

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

3.2 INSTALLATION

A. General: Install fire extinguishers [and mounting brackets] in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

1. Mounting Height: Top of fire extinguisher to be at [42 inches]<Insert dimension> above finished floor.

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END OF SECTION 104416

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SECTION 105113 - METAL LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Welded athletic lockers.
2. Locks.
3. Locker benches.

B. Related Requirements:

1. Section 105113.13 "Coin-Operated Metal Lockers" for coin-operated lockers used in public facilities for temporary storage of personal belongings.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference [at Project site][by web conference]<Insert location>.

1.3 ACTION SUBMITTALS

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

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker [and bench].

B. Shop Drawings: For metal lockers.

1. Include plans, elevations, sections, and attachment details.
2. Show locker trim and accessories.
3. Include locker identification system and numbering sequence.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available.

D. Samples for Verification: For the following products, in manufacturer's standard size:

1. Lockers and equipment.
2. Locker benches.

E. Product Schedule: For lockers. [Use same designations indicated on Drawings.]

F. Sustainable Design Submittals:

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1. Third-Party Certifications: For each product.
2. Third-Party-Certified Life-Cycle Assessment: For each product.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For Installer.

B. Sample Warranty: For specified special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Locker Hardware: The following metal locker hardware items equal to [10]<Insert number> percent of amount installed for each type and finish installed, but no fewer than [five]<Insert number> units:

a. Locks.
b. Blank identification plates.
c. Hooks.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

B. Delivery to Owner: Deliver [master and control keys][combination control charts] to Owner by registered mail or overnight package service.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.9 COORDINATION

A. Coordinate sizes and locations of [concrete][concrete masonry][wood] bases for metal lockers.

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B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Faulty operation of latches and other door hardware.

2. Damage from deliberate destruction and vandalism is excluded.
3. Warranty Period for Knocked-Down Metal Lockers: [Two]<Insert number> years from date of Substantial Completion.
4. Warranty Period for Welded Metal Lockers: [Lifetime][10 years]<Insert years> from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain metal lockers [, locker benches,] and accessories from single source from single locker manufacturer.

1. Obtain locks from single lock manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: For lockers [and locker benches] indicated to be accessible, comply with applicable provisions in [the USDOJ's "2010 ADA Standards for Accessible Design"][the ABA standards of the Federal agency having jurisdiction][and][ICC A117.1]<Insert requirement>.

2.3 WELDED LOCKERS

A. Welded Athletic Lockers:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

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a. ASI Storage Solutions
b. DEBOURGH ALL-AMERICAN LOCKERS
c. List Industries Inc.

2. Perforated Doors: One piece; fabricated from 0.075-inch nominal-thickness steel sheet with manufacturer's standard diamond perforations; formed into channel shape with double bend at [vertical edges and with right-angle single bend at horizontal edges][and][latch point (bottom) and right-angle single bend at remaining edges for box lockers].

    a. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.

3. Expanded-Metal Doors: Fabricated from 0.090-inch nominal-thickness expanded metal; welded to 0.105-inch nominal-thickness steel angle frame; with 0.090-inch nominal-thickness, steel sheet lock panel backed by 0.060-inch nominal-thickness, steel sheet retainer welded to door frame.
4. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:

    a. Tops and Bottoms: 0.060-inch nominal thickness, with single bend at edges.
    b. Backs: 0.048-inch nominal thickness.
    c. Shelves: 0.060-inch nominal thickness, with double bend at front and single bend at sides and back.

5. Unperforated Sides: Fabricated from 0.060-inch nominal-thickness steel sheet.
6. Perforated Sides: Fabricated from 0.060-inch nominal-thickness steel sheet with manufacturer's standard diamond perforations.
7. Expanded-Metal Sides: Fabricated from 0.090-inch nominal-thickness expanded metal; welded to 0.105-inch nominal-thickness steel angles or 0.060-inch nominal-thickness steel channel frames.
8. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet or 0.097-inch nominal-thickness steel angles; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.

    a. Cross Frames for Double-Tier Lockers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
    b. Cross Frames for Triple-Tier Lockers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.

9. Reinforced Bottoms: Structural channels, formed from 0.075-inch nominal-thickness steel sheet; welded to front and rear of side-panel frames.
10. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees [; self-closing].

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a. Knuckle Hinges: Steel, full loop, five or seven knuckles, tight pin; minimum 2 inches high. Provide no fewer than three hinges for each door more than 42 inches high.
b. Continuous Hinges: Manufacturer's standard, steel; side or top mounted as required by locker configuration.
c. Hinges: Manufacturer's standard, steel, continuous or knuckle type.

11. Recessed Door Handle and Latch: Stainless steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.

    a. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in cylinder locks, or padlocks; positive automatic latching and prelocking.

        1) Latch Hooks: Equip doors 48 inches and higher with three latch hooks and doors less than 48 inches high with two latch hooks; fabricated from 0.120-inch nominal-thickness steel sheet; welded to full-height door strikes; with resilient silencer on each latch hook.
        2) Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.

    b. Single-Point Latching: Nonmoving latch hook [designed to engage bolt of built-in combination or cylinder lock][with steel padlock loop that projects through recessed cup and is finished to match metal locker body].

        1) Latch Hook: Equip each door with one latch hook, fabricated from 0.120-inch nominal-thickness steel sheet; welded midway up full-height door strike; with resilient silencer.

12. Projecting Turn-Handle and Latch: Steel handle welded to manufacturer's standard, three-point, cremone-type latching mechanism consisting of steel rods or bars that engage locker frame at top and bottom of door, and center latch that engages strike jamb; with steel padlock loop.
13. Door Handle and Latch for Box Lockers: Stainless steel strike plate with integral pull; with steel padlock loop that projects through metal locker door.
14. Locks: Combination padlocks.
15. Identification Plates: Manufacturer's standard, etched, embossed, or stamped [aluminum][plastic] plates, with numbers and letters at least 3/8 inch high.
16. Hooks: Manufacturer's standard ball-pointed, aluminum or steel; zinc plated.
17. Coat Rods: Manufacturer's standard.
18. Legs: [6 inches]<Insert dimension> high; formed by extending vertical frame members, or fabricated from 0.075-inch nominal-thickness steel sheet; welded to bottom of locker.

    a. Closed Front and End Bases: Fabricated from 0.048-inch nominal-thickness steel sheet.

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19. Continuous Zee Base: 4 inches high; fabricated from 0.075-inch nominal-thickness steel sheet.
20. Continuous Sloping Tops: Fabricated from 0.048-inch nominal-thickness steel sheet, with a pitch of approximately 20 degrees.

    a. Closures: [Vertical][Hipped] -end type.

21. Recess Trim: Fabricated from 0.048-inch nominal-thickness steel sheet.
22. Filler Panels: Fabricated from 0.048-inch nominal-thickness steel sheet.
23. Boxed End Panels: Fabricated from 0.060-inch nominal-thickness steel sheet.
24. Finished End Panels: Fabricated from 0.024-inch nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
25. Materials:

    a. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
    b. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with A60 zinc-iron, alloy (galvannealed) coating designation.
    c. Expanded Metal: ASTM F1267, Type II (flattened), Class I (uncoated), 3/4-inch steel mesh, with at least 70 percent open area.
    d. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent.

26. Finish: Baked enamel or powder coat.

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

2.4 LOCKS

A. Combination Padlock : [Key-controlled, three-number dialing combination locks; capable of five combination changes][Provided by Owner].

2.5 LOCKER BENCHES

A. Locker Bench:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. ASI Storage Solutions
    b. List Industries Inc.

2. Provide bench units with overall assembly height of [17-1/2 inches]<Insert dimension>.
3. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.

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a. Size: Minimum 9-1/2 inches wide by 1-1/4 inches thick[except provide 20- to 24-inch- wide tops where accessible benches are indicated].
b. Laminated clear hardwood with one coat of clear sealer on all surfaces and one coat of clear lacquer on top and sides.
c. Plastic laminate over particleboard core, with two steel tubes running full length of top and positioned to receive pedestal fasteners.

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

d. Extruded aluminum with clear anodic finish.

4. Fixed-Bench Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors, and as follows:

a. Tubular Steel:

1) 1-1/2-inch- diameter steel tubing threaded on both ends, with standard pipe flange at top and bell-shaped cast-iron base; with baked-enamel or powder-coat finish; anchored with exposed fasteners.
2) 1-1/4-inch- diameter steel tubing, with 0.1265-inch- thick steel flanges welded at top and base; with [baked-enamel][zinc-plated] finish; anchored with exposed fasteners.
3) Color: As selected by Architect from manufacturer's full range.

5. Movable-Bench Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top, complete with fasteners, and as follows:

a. Aluminum: 1/8-inch-thick by 3-inch-wide channel or 1/4-inch-thick by 3-inch-wide bar stock, shaped into [trapezoidal][inverted-T] form; with nonskid pads at bottom.

1) Finish: [Clear][Black][Gold] anodic finish.

b. Stainless Steel: 1/8-inch-thick by 3-inch-wide channel or 1/4-inch-thick by 3-inch-wide bar stock, shaped into trapezoidal form; with nonskid pads at bottom.

1) Finish: [Manufacturer's standard][No. 4B].

6. Materials:

a. Stainless Steel Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, Type 304.
b. Plastic Laminate: ISO 4586-3, Grade HGP.
c. Extruded Aluminum: ASTM B221, alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated.
d. Steel Tube: ASTM A500/A500M, cold rolled.
e. Particleboard: ANSI A208.1, Grade M-2.
f. Composite Wood Products: Verify products are made using ultra-low-

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emitting formaldehyde resins, as defined in CARB 93120, "Airborne Toxic Control Measure (ATCM) for Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.

g. Composite Wood Products: Verify formaldehyde emission rates are not greater than the following when tested in accordance with ASTM D6007 or ASTM E1333:

1) Hardwood Plywood: 0.05 ppm.
2) Particleboard: 0.09 ppm.
3) MDF More Than 5/16 Inch (8 mm) Thick: 0.11 ppm.
4) MDF 5/16 Inch (8 mm) or Less in Thickness: 0.13 ppm.

2.6 FABRICATION

A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.

B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.

C. Equipment: Provide each locker with an identification plate and the following equipment:

1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
2. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
3. Triple-Tier Units: One double-prong ceiling hook.
4. Coat Rods: [As indicated on Drawings][For each compartment of each locker][In lieu of ceiling hook for metal lockers 24 inches high or more][In lieu of ceiling hook for metal lockers 18 inches deep or more].
5. Open-Front Athletic Lockers: Two single-prong wall hooks bolted to locker back and coat rod.

D. Knocked-Down Construction: Fabricate metal lockers by [assembling at Project site][preassembling at plant prior to shipping], using manufacturer's nuts, bolts, screws, or rivets.

E. Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds smooth and flush.

F. Accessible Lockers: Fabricate as follows:

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1. Locate bottom shelf no lower than 15 inches above the floor.
2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

G. Continuous Zee Base: Fabricated in lengths as long as practical to enclose base and base ends; finished to match lockers.

H. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.

1. Sloping-top corner fillers, mitered.

I. Individual Sloping Tops: Fabricated in width to fit one locker frame in lieu of flat locker tops; with integral back; finished to match lockers. Provide wedge-shaped divider panels between lockers.

J. Recess Trim: Fabricated with minimum 2-1/2-inch face width and in lengths as long as practical; finished to match lockers.

K. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.

L. Boxed End Panels: Fabricated with 1-inch- wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.

1. Provide one-piece panels for double-row (back-to-back) locker ends.

M. Finished End Panels: Fabricated to conceal unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

1. Provide one-piece panels for double-row (back-to-back) locker ends.

N. Center Dividers: Full-depth, vertical partitions between bottom and shelf; finished to match lockers.

2.7 ACCESSORIES

A. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.

B. Anchors: Material, type, and size required for secure anchorage to each substrate.

1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls [, and elsewhere as indicated,] for corrosion resistance.
2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 INSTALLATION OF METAL LOCKERS

A. Install lockers level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
2. Anchor single rows of metal lockers to walls near top [and bottom of lockers][of lockers and to floor].
3. Anchor back-to-back metal lockers to floor.

B. Knocked-Down Lockers: Assemble with manufacturer's standard fasteners, with no exposed fasteners on door faces or face frames.

C. Welded Lockers: Connect groups together with manufacturer's standard fasteners, with no exposed fasteners on face frames.

D. Equipment:

1. Hooks: Attach hooks with at least two fasteners.
2. Locks: Attach door locks on doors using security-type fasteners.
3. Identification Plates: Identify metal lockers with identification indicated on Drawings.

    a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
    b. Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.

E. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Recess Trim: Attach to recessed metal lockers with concealed clips.
2. Filler Panels: Attach with concealed fasteners. Locate filler panels where indicated on Drawings.

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3. Sloping-Top Units: Attach to metal lockers, with closures at exposed ends.
4. Boxed End Panels: Attach using concealed fasteners to conceal exposed ends of nonrecessed metal lockers.
5. Finished End Panels: Attach using fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

3.3 INSTALLATION OF LOCKER BENCHES

A. Fixed Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

B. Movable Benches: Place benches in locations indicated on Drawings.

3.4 ADJUSTING

A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. [Verify that integral locking devices operate properly.]

3.5 PROTECTION

A. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105113

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SECTION 105129 - PHENOLIC LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Phenolic lockers.
2. Phenolic locker benches.

1.2 ACTION SUBMITTALS

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

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. <Insert requirements>.

B. Shop Drawings:

1. Plans, elevations, sections, and attachment details.
2. Details full size.
3. Locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Locations and sizes of cutouts and holes for items installed in lockers.
5. Locker fillers, trim, base, sloping tops, and accessories.
6. Locker identification system and numbering sequence.
7. <Insert requirements>.

C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of phenolic locker. Include full range of available options for hardware and accessories involving material, finish, and/or color selection.

D. Samples for Verification: Actual sample of finished products for each type of phenolic locker, hardware, and accessory.

1. Size: [Manufacturers' standard size]<Insert size>.

E. Delegated Design Submittals: For seismic restraint of lockers, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For phenolic panel, by a qualified testing agency.

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B. Qualification Statements: For Installer.

C. Delegated design engineer qualifications.

D. Sample Warranties: For phenolic lockers.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For phenolic lockers including adjusting, repairing, and replacing locker doors and latching mechanisms.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Materials: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Locker doors, complete with specified door hardware. Furnish no fewer than [five]<Insert number> doors of each type and color installed.
2. Units of the following locker hardware items equal to [10]<Insert number> percent of amount installed for each type and finish installed, but no fewer than [five]<Insert number> units:

    a. Hinges.
    b. Pulls.
    c. Cylinder locks.
    d. Blank number identification plates.
    e. Hooks.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: [Fabricator of products][Entity that employs installers and supervisors who are trained and approved by manufacturer][Authorized representative who is trained and approved by manufacturer].

B. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in [state]<Insert jurisdiction> where Project is located and who is experienced in providing engineering services of the type indicated.

1.7 MOCKUPS

A. 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 corner [, including one locker on each side of corner and corner filler][, including door panel with specified door hardware]<Insert Project-specific requirements>, as indicated on Drawings.

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2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver lockers until spaces to receive them are clean, dry, and ready for their installation.

B. Deliver [master and control keys][combination control charts] to Owner by registered mail or overnight package service [.][, addressed as follows:]

1. <Insert name and address of Owner's representative>.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of construction contiguous with lockers by field measurements, and coordinate before fabrication.

1.10 COORDINATION

A. Coordinate sizes and locations of concealed wood support bases.

1. Requirements are specified in Section 061000 "Rough Carpentry."

B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that lockers can be supported and installed as indicated.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of lockers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Faulty operation of locks or hardware.
c. Deterioration of finishes and materials beyond normal use.
d. <Insert failure modes>.

2. Warranty Period: [Ten]<Insert number> years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain phenolic lockers [, phenolic locker benches,][and hardware and accessories] from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: [25][75][200] or less.
2. Smoke-Developed Index: 450 or less.

B. Accessibility Regulations: Comply with applicable provisions in [the USDOJ's "2010 ADA Standards for Accessible Design"][and][ICC A117.1]<Insert accessibility regulation> for lockers [and locker benches] designated as accessible.

C. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraint of lockers.

D. Seismic Performance: Lockers to withstand the effects of earthquake motions determined in accordance with [ASCE/SEI 7]<Insert requirement>.

2.3 PHENOLIC LOCKERS

A. Phenolic Lockers:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. ASI Storage Solutions
    b. List Industries Inc.

2. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent.
3. Recycled Content: Provide manufacturer documentation for recycled content, indicating postconsumer and preconsumer recycled content.
4. Construction Style: Manufacturer's standard factory-assembled flush overlay units.
5. Locker Body: Solid phenolic-core material with melamine facing on both sides fused to substrate during manufacture (not separately laminated), and with beveled and polished edges.

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a. Thickness:

1) Side Panels: Manufacturer's standard.
2) Back Panel: Manufacturer's standard.
3) Top Panel: Manufacturer's standard.
4) Bottom Panel: Manufacturer's standard.

6. Doors: Solid phenolic-core material with melamine facing on both sides fused to substrate during manufacture (not separately laminated), and with beveled and polished edges.

a. Thickness: Manufacturer's standard.

7. End Panels: Match style, material, construction, thickness, and finish of doors.
8. Fixed Shelves: Match style, material, construction, and finish of locker body.

a. Thickness: 1/2 inch.

9. Corners and Filler Panels: Match style, material, construction, thickness, and finish of doors.
10. Continuous Finish Base: Match style, material, construction, thickness, and finish of doors; fabricated in lengths as long as practical to enclose base and base ends of lockers.
11. Continuously Sloping Tops: Match style, material, construction, thickness, and finish of doors, for installation over lockers with separate flat tops. Fabricate tops in lengths as long as practical, without visible fasteners at splice locations. Provide fasteners, supports, and closures, as follows:

a. Closures: [Vertical][Hipped] -end type.
b. Sloping-top corner fillers, mitered.

12. Phenolic Locker Finish:

a. Black-Core Phenolic:

1) Facing Sheet Color:

a) Locker Body: As selected by Architect from manufacturer's full range.
b) Doors: As selected by Architect from manufacturer's full range.

2) Exposed Edges: Manufacturer's standard black edge.

b. Through-Color Phenolic:

1) Color:

a) Locker Body: As selected by Architect from manufacturer's full range.
b) Doors: As selected by Architect from manufacturer's full range.

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13. Wood Support Base: 2-by-4-inch nominal -size lumber treated with manufacturer's standard preservative-treatment, pressure process.
14. Pedestal Supports: Provide adjustable pedestal support legs [with all necessary hardware for attachment of continuous finish base].

2.4 HARDWARE

A. Locking Device:

1. Padlock Hasp: [Recessed][Surface mounted], steel, through bolted.

    a. Finish: [Manufacturer's standard][As selected by Architect from manufacturer's full range]<Insert finish>.

2. Cam Padlock Hasp: Surface mounted, steel.

    a. Finish: [Manufacturer's standard][As selected by Architect from manufacturer's full range]<Insert finish>.

3. Cylinder Lock: Built-in, flush cam locks with five-pin tumbler keyway, keyed separately and master keyed. Furnish two change keys for each lock and [two]<Insert number> master keys.

    a. Key Type: [Flat][Grooved][, with minimum 2-by-2.68-inch key head for accessible lockers].
    b. Bolt Operation: [Manually locking deadbolt][or][automatically locking spring bolt].

4. Built-in Dial Combination Lock: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key. [Provide escutcheon plate with finish to match other locker hardware.]

    a. Bolt Operation: [Manually locking deadbolt][or][automatically locking spring bolt].

5. Built-in Push-Button Combination Lock: Mechanical combination locks; capable of at least 2000 combination changes.

    a. Bolt Operation: [Manually locking deadbolt][or][automatically locking spring bolt].
    b. Finish: [Manufacturer's standard][As selected by Architect from manufacturer's full range]<Insert finish>.

6. Built-in, Coin-Operated Lock: Self-contained units mounted to door interior with replaceable lock cylinders keyed separately and master keyed. Mount instruction decals to both door faces. Furnish one change key for each lock and one master key.

    a. Bolt Operation: [Manually locking deadbolt][or][automatically locking spring

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bolt].

b. Lock Type: Fee [return/deposit][collect/pay].
c. Fee Type: [Token][Coin, two quarters][Coin, three quarters]<Insert amount>.
d. Coin Box: Mount collection box to lock unit, key collection boxes alike. Furnish with removable cylinder and key.

7. Built-in, Card-Operated Lock: Self-contained units mounted to door interior with replaceable lock cylinders, keyed separately and master keyed. Mount instruction decals to both door faces. Furnish one change card key for each lock and one master card key.

   a. Bolt Operation: [Manually locking deadbolt][or][automatically locking spring bolt].

8. Digital Lock: Battery-powered electronic [touch RFID][keypad] operation with shared- or assigned-use functionality with LED usage indicator and auto-unlock; managed with electronic keys or mobile device.

   a. Style: [Standard][Vertical][Horizontal] body style; [with][without] pull handle.
   b. Finish: [Manufacturer's standard][As selected by Architect from manufacturer's full range]<Insert finish>.

9. <Insert requirement>.

B. Hinges:

1. Manufacturer's standard.
2. Butt Hinges: 2-3/4-inch, five-knuckle stainless steel hinges; back mounted, with not less than 120 degrees of opening.

   a. Provide two hinges for doors [36 inches][42 inches] high and less.
   b. Provide three hinges for doors more than [36 inches][42 inches] high.

3. Continuous Hinges: Full height, back mounted; [manufacturer's standard material and finish]<Insert requirements>.
4. Frameless Hinges (European Type): Fully concealed [, self-closing], with not less than 110 degrees of opening; [manufacturer's standard material and finish]<Insert requirements>.

   a. Provide two hinges for doors [36 inches][42 inches] high and less.
   b. Provide three hinges for doors more than [36 inches][42 inches] high.

C. Handle:

1. Wire Pulls: Back mounted.

   a. Size: [4 inches long, 5/16 inch in diameter][5 inches long, 2-1/2 inches deep, and 5/16 inch in diameter][Manufacturer's standard].
   b. Material and Finish: [Manufacturer's standard][As selected by Architect from manufacturer's full range]<Insert material and finish>.

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2. Recessed Handle: Recessed cup with integral door pull.

    a. Material and Finish: [Manufacturer's standard][As selected by Architect from manufacturer's full range]<Insert material and finish>.

3. Accessible Handle: Metal, fixed, graspable lever handle and rose trim; surface mounted.

    a. Material and Finish: [Manufacturer's standard][As selected by Architect from manufacturer's full range]<Insert material and finish>.

4. <Insert requirement>.

D. Hooks: Ball-pointed hooks. Attach hooks with at least two fasteners.

1. Hook Configuration:

    a. Manufacturer's standard.
    b. Provide hooks as indicated on Drawings.
    c. Provide [one double-prong ceiling hook][and][two single-prong wall hooks][two double-prong wall hooks][one single-prong wall hook][one double-prong wall hook] for each compartment of [single-tier][double-tier][triple-tier] lockers.
    d. Provide one double-prong ceiling hook for each compartment of interlocking lockers.

2. Material and Finish: [Manufacturer's standard][As selected by Architect from manufacturer's full range]<Insert material and finish>.

E. Coat Rods:

1. Size: [1-inch-][3/4-inch-][Manufacturer's standard] diameter steel.
2. Configuration:

    a. Provide coat rods as indicated on Drawings.
    b. Provide coat rod for each compartment of [single-tier][double-tier][triple-tier][and][interlocking] lockers.
    c. Provide coat rod in lieu of ceiling hook for lockers 24 inches high or taller.

3. Finish: [Manufacturer's standard][As selected by Architect from manufacturer's full range]<Insert finish>.

2.5 ACCESSORIES

A. Number Identification:

1. Manufacturer's standard.
2. Number Plates: [1-1/2-inch- diameter][1-1/2-by-1-1/2-inch- square][1-1/2-by-2-1/4-inch- rectangular], etched, embossed, or stamped, aluminum or stainless steel plates with black numbers and letters at least 3/8 inch high. Identify lockers

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in sequence indicated on Drawings.

3. Vinyl Numbers: [1-1/2-inch-][1-inch-][2-inch-] high, 2.5-mil thick, PVC film numbers with clear solvent-based permanent adhesive. Identify lockers in sequence indicated on Drawings.
4. <Insert requirements>.

2.6 MATERIALS

A. Anchors: Material, type, size, and finish as required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

2.7 FABRICATION

A. Fabricate each locker with shelves, an individual door and frame, an individual top, a bottom, and a back, and with common intermediate uprights separating compartments.

1. Fabricate lockers to dimensions, profiles, and details indicated.

B. Fabricate lockers square, rigid, without warp, and with finished faces flat and free of dents, scratches, and chips. Accurately factory machine components for attachments. Make joints tight and true.

C. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches above the floor.
2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

D. Venting: Fabricate lockers with space between doors and locker assembly of not less than [1/4 inch]<Insert dimension>.

E. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Use only manufacturer's nuts, bolts, screws, and other devices for assembly.

F. Shop cut openings, to maximum extent possible, to receive hardware, 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.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify that furring is attached to concrete and masonry walls that are to receive lockers.

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

3.2 INSTALLATION OF PHENOLIC LOCKERS

A. Install wood support base [with 1/2-inch- thick, plywood top].

B. Install lockers level, plumb, and true; shim as required, using concealed shims.

1. Connect single rows of lockers together side-to-side at each locker. Connect back-to-back lockers together side-to-side at each locker and back-to-back at [each locker][every other locker]<Insert requirements>. Use manufacturer's standard connecting bolts, through predrilled holes, with no exposed fasteners on face frames. Fit lockers accurately together to form flush, tight, hairline joints.
2. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c., using manufacturer's standard concealed fasteners for material indicated.

    a. Anchor single rows of lockers to walls near top [and bottom of lockers][of lockers and to wood support base].
    b. Anchor back-to-back lockers to wood support base.
    c. Install seismic restraints.

C. Install lockers without distortion so doors fit openings properly and are accurately aligned. Adjust hardware to center doors in openings, providing unencumbered operation. Complete installation of hardware and accessory items as indicated.

D. Installation Tolerance: No more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line. Shim as required with concealed shims.

E. Scribe and cut corner and filler panels to fit adjoining work using fasteners concealed where practical. Repair damaged finish at cuts.

F. Attach sloping-top units to lockers, with end panels covering exposed ends.

G. Install number identification plates after lockers are in place.

1. Attach number identification plate on each locker door, near top, centered, with at least two screws with finish matching the plate.

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H. Fixed Locker Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

I. Movable Locker Benches: Place benches in locations indicated on Drawings.

3.3 ADJUSTING

A. Clean, lubricate, and adjust hardware. Adjust doors to operate easily without binding. [Verify that integral locking devices operate properly.]

3.4 PROTECTION

A. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Touch up marred finishes, or replace lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105129

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SECTION 107119 – FLOOD BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

Stackable aluminum flood barriers and associated installation materials

B. References:

1. FEMA Technical Bulletin 3 2021 Requirements for the Design and Certification of Dry Floodproofed Non-Residential and Mixed-Use Buildings
2. FEMA Homeowners Guide to Retrofitting Flood P-312
3. FEMA Design Manual for Retrofitting Flood-Prone Residential Structures #114
4. NFIP Title 44 US Code of Federal Regulations, Section 60.3
5. ASCE 24-98, ASCE/SEI 24-05
6. FIRM (Flood Insurance Rate Map)

1.2 ALLOWANCES

A. See Section 012100 "Allowances" for description of allowances affecting items specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples: For each type of barrier and frame and for each finish specified, complete assembly minimum 6 by 6 inches in size.

C. Product Schedule: For flood barriers and frames. [Use same designations indicated on Drawings.]

1.4 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Reports

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B. Qualification Statements: For testing and inspecting agency

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

A. Flood barriers shall be structurally sound, easy to deploy by a single individual, impact resistant and conforming to applicable performance requirements.

B. Except as otherwise indicated, requirements for aluminum flood barriers, terminology, tolerances, standards of performance and workmanship are those specified in NFIP Section 60.3.

C. Design Flood Elevation (DFE), Base Flood Elevation (BFE) and Building Sub Elevations shall be furnished to barrier manufacturer by the project architect, surveyor, or engineer.

D. All Barrier heights shall be finished to at least 12" above the BFE.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Design Criteria Barriers shall conform to the requirements for A and AE Zones as set forth by the NFIP.

B. Manufacturer Criteria The manufacturer should have a minimum of 2 years history and experience in the product line.

C. Performance Criteria

1. Hydrostatic Pressure Resistance - Flood Barriers shall be constructed to resist lateral forces due to hydrostatic pressure from freestanding water as referenced in FEMA Technical Bulletin 3-93.
2. Hydrodynamic Force Resistance - Flood Barriers shall conform to the criteria for resisting lateral forces due to moving flood waters as set forth by FEMA Technical Bulletin 3-93.
3. Debris Impact Force Resistance - Flood Barriers shall conform to the criteria for resisting debris impact as prescribed by FEMA Technical Bulletin 3-93.

D. Access / Egress Requirement Provide for a fully removable system including all cross members or panels spanning the opening. Permanent frame assemblies

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shall be non-removable or removable as determined by manufacturer based on installation requirements.

E. Finite Element Analysis Testing Requirement The system shall have been run through Finite Element Analysis testing, to confirm its ability to handle expected hydrostatic pressures. Report shall show maximum height and width loading capabilities equal to or greater than project opening sizes and specified DFE heights.

2.2 FLOOD BARRIERS AND FRAMES

A. Flood Barriers and frames:

Manufacturers: FLOOD BARRIER SHALL BE MODEL FASTLOGSTM-SD AS MANUFACTURED BY PRESRAY CORPORATION.

2.3 MATERIALS

A. Stop Logs: Presray AL606-T6 aluminum channels.

B. Frames: Presray AL606-T6 Jamb Extrusion; no sills necessary unless mandated by Presray Engineering. Steel jambs optional for certain conditions.

C. Finish: Stop logs mill-finish aluminum; jambs mill-finish aluminum. Steel jambs (if used) primed with one coat rust inhibitive, lead free, red primer.

D. Gasket: Presray type high-density closed cell neoprene sponge with skin, retained in the stop logs and jambs.

E. Hardware: Presray Compression Brackets; Presray Hold Down Brackets; KN8C Turn Knobs.

F. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329/F2329M.

2.4 FABRICATION

A. Stop logs shall be designed with a minimum 2:1 factor of safety based on material yield strength, and shall provide an effective seal against the design flood level.

B. Frame shall have mounting holes for concrete anchors and bolts (options available include epoxy anchors for block walls, and studs for imbedment in concrete).

C. Fabricate aluminum flood barriers to comply with the requirements for

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protection to the Design Flood Elevation (DFE), at the specified opening dimensions, using specified materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates 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 INSTALLATION OF FLOOD BARRIERS

A. Contractor shall prepare surfaces to receive flood barriers and provide surfaces that are paper smooth, true, and plumb.

B. Contractor shall provide field measurements of all openings, "masonry to masonry", and confirm that openings are prepared to receive the necessary flood barrier hardware and components.

C. Install flood barriers in accordance with manufacturers installation instructions.

D. Apply sealants where appropriate per the manufacturer's installation instructions.

E. Installer shall insert all removable flood barrier components to confirm fit and remove said components after initial installation.

F. Flood barriers shall be transported by the building contractor to the designated inside storage area to be stored in a manner protective of the system gaskets and seal.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: [Engage] a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Flood Barriers: Inspect each barrier for conformance with designed flood elevation requirements, and certify compliance with all required heights needed to conform with 500 year flood elevation requirements called out within design documents.

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C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each flood barrier indicating compliance with each item listed in performance criteria listed above.

3.4 ADJUSTING

A. Adjust barriers and hardware, after installation, for proper operation.

PART 4 - WARRANTY

4.1 WARRANTY

1 YEAR LIMITED WARRANTY AGAINST DEFECTS AND WORKMANSHIP FROM DATE OF SHIPMENT

END OF SECTION 08316

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SECTION 113013 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cooking appliances.
2. Kitchen exhaust ventilation.
3. Refrigeration appliances.
4. Cleaning appliances.

B. Related Requirements:

1. Section 224100 "Residential Plumbing Fixtures" for kitchen sinks, dishwasher air-gap fittings, waste (garbage) disposers, and instant hot-water dispensers.

1.2 ALLOWANCES

A. Furnish residential appliances as part of residential appliance allowance.

B. Furnish <Insert item and drawing designation> as part of [residential appliance]<Insert allowance designation> allowance.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]<Insert location>.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include installation details, material descriptions, dimensions of individual components, and finishes for each appliance.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Samples: For each exposed product and for each color and texture specified, in [manufacturer's standard]<Insert dimensions> size.

C. Product Schedule: For appliances. [Use same designations indicated on Drawings.]

D. Sustainable Design Submittals:

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1. Product Data: For water-efficient clothes washer, indicating compliance with requirements.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Certificates: For each type of appliance.

C. Field quality-control reports.

D. Sample Warranties: For manufacturers' special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintains, within <Insert miles> of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

B. Gas-Fuel Conversion: Provide gas-fueled appliances with manufacturer's [high-altitude][and][propane] conversion kit installed by a qualified service agency according to manufacturer's written instructions for Project location and type of fuel.

1.8 WARRANTY

A. Special Warranties: Manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period [.][except as qualified below:]

1. Warranty Period: [Two][Five]<Insert number> years from date of Substantial Completion.

B. Electric Cooktop and Range: [Full warranty, including parts and labor,][Limited warranty, including parts and labor for first year and parts thereafter,]<Insert description> for on-site service on surface-burner elements.

1. Warranty Period: [Two][Five]<Insert number> years from date of Substantial Completion.

C. Microwave Oven: [Full warranty, including parts and labor,][Limited warranty, including parts and labor for first year and parts thereafter,] for on-site service [on the magnetron tube]<Insert requirement>.

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1. Warranty Period: [Two][Five]<Insert number> years from date of Substantial Completion.

D. Refrigerator/Freezer, Freezer, and Icemaker, Sealed System: [Full warranty, including parts and labor,][Limited warranty, including parts and labor for first year and parts thereafter,] for on-site service on the product.

1. Warranty Period for [Sealed Refrigeration System]<Insert item>: [Two][Five]<Insert number> years from date of Substantial Completion.
2. Warranty Period [for Other Components]<Insert requirement>: [Two]<Insert number> years from date of Substantial Completion.

E. Dishwasher: [Full warranty, including parts and labor,][Limited warranty, including parts and labor for first year and parts thereafter,] for on-site service on the product.

1. Warranty Period for [Deterioration of Tub and Metal Door Liner]<Insert requirement>: [Three][Five][10]<Insert number> years from date of Substantial Completion.
2. Warranty Period [for Other Components]<Insert requirement>: [Two]<Insert number> years from date of Substantial Completion.

F. Clothes Washer: [Full warranty, including parts and labor,][Limited warranty, including parts and labor for first year and parts thereafter,]<Insert description> for on-site service on the product.

1. Warranty Period: [Two][Three]<Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain [residential appliances from single source][and][each type of residential appliance from single manufacturer].

2.2 PERFORMANCE REQUIREMENTS

A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Gas-Fueled Appliances: Certified by a qualified testing agency for each type of gas-fueled appliance according to ANSI Z21 Series standards.

C. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with applicable provisions in [the DOJ's 2010 ADA Standards for Accessible Design][the ABA standards of the Federal agency having jurisdiction][and][ICC A117.1]<Insert requirement>.

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2.3 COOKING APPLIANCES

A. Gas Range: [Freestanding][Slide-in] range with one oven(s).

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. GE Appliances; Haier Group

2. Width: 30 inches.
3. Gas Burners: Four.

    a. Power Ratings: Manufacturer's standard.
    b. Controls: [Digital panel][Manual-dial] controls, located on [front][left side][right side][splash panel at rear of rangetop].
    c. Grates: [Individual][Continuous]<Insert description>.
    d. Other Feature(s): [Sealed burners][auto-reigniting burners][and][grill]<Insert feature>.

4. Oven Features:

    a. Capacity: [3.3 cu. ft.][and]<Insert capacity for each oven>.
    b. Operation: [Baking][convection][and][pyrolytic self-cleaning or catalytic continuous cleaning]<Insert requirement>.
    c. Broiler: Located in top of oven.
    d. Oven Door(s): Counterbalanced, removable, with [observation window][and][full-width]<Insert type of handle> handle.
    e. Gas Power Ratings:

        1) Oven(s): Manufacturer's standard.
        2) Broiler: Manufacturer's standard.

    f. Controls: [Digital panel][Manual-dial] controls and timer display, located on [front][left side][right side][splash panel at rear of rangetop].
    g. <Insert feature>.

5. Anti-Tip Device: Manufacturer's standard.
6. Electric Power Supply: [120 V, 60 Hz, 1 phase, 15 A][As indicated on Drawings]<Insert requirement>.
7. Material: Stainless steel with [manufacturer's standard][ceramic-glass]<Insert material> cooktop.

    a. Color/Finish: fingerprintless stainless steel.

B. Microwave Oven:

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:

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a. GE Appliances; Haier Group

2. Mounting: counter top.
3. Type: Conventional.
4. Dimensions:

    a. Width: 24 inches As indicated on Drawings.
    b. Depth: 19-1/2 inches As indicated on Drawings.
    c. Height: 14 inches.

5. Capacity: 2.0 cu. ft..
6. Oven Door: Door with observation window and pushbutton latch release.
7. Exhaust Fan: [Variable][Two][Four] -speed fan, nonvented, recirculating type with charcoal filter and with manufacturer's standard capacity.
8. Microwave Power Rating: Manufacturer's standard.
9. Electric Power Supply: As indicated on Drawings.
10. Controls: Digital panel controls and timer display.
11. Other Features: [Turntable][temperature probe][and][lock-out feature]<Insert feature>.
12. Material: Stainless steel.

    a. Color/Finish: fingerprintless stainless steel.

2.4 KITCHEN EXHAUST VENTILATION

A. Overhead Exhaust Hood:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. Broan-NuTone

2. Type: Wall-mounted, exhaust-hood system.
3. Dimensions:

    a. Width: 30 inches.
    b. Depth: As indicated on Drawings.

4. Exhaust Fan: Three -speed fan built into hood and with manufacturer's standard capacity.

    a. Venting: Vented to outside through wall with weatherproof wall cap, backdraft damper, and rodent-proof screening.
    b. Fan Control: Hood -mounted [touch-pad to control] fan switch, with separate hood-light control switch.

5. Duct Type: Manufacturer's standard.
6. Finish: Stainless steel.

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a. Color: stainless.

7. Features:

a. Permanent, washable stainless steel-mesh filter(s).
b. Built-in halogen lighting.
c. Warming lamp socket(s).
d. <Insert feature>.

2.5 REFRIGERATION APPLIANCES

A. Refrigerator/Freezer: Two-door refrigerator/freezer with freezer on bottom and complying with AHAM HRF-1.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. GE Appliances; Haier Group

2. Type: Freestanding.
3. Dimensions:

a. Width: 36 inches.
b. Depth: 33-1/4 inches.
c. Height: 70 inches.

4. Storage Capacity:

a. Refrigeration Compartment Volume: [15.6 cu. ft.]<Insert volume>.
b. Freezer Volume: [5.13 cu. ft.]<Insert volume>.
c. Shelf Area: [Three]<Insert number> adjustable [wire][glass] shelves, [26 sq. ft.]<Insert area>.
d. <Insert storage requirement>.

5. General Features:

a. Door Configuration: Overlay.
b. Dispenser in door for [ice][and][cold water][with dispenser lock].
c. Built-in water-filtration system.
d. Dual refrigeration systems.
e. Separate [touch-pad] temperature controls for each compartment.
f. <Insert feature>.

6. Refrigerator Features:

a. Interior light in refrigeration compartment.
b. Compartment Storage: [Wine racks][vegetable crisper][and][meat compartment]<Insert requirement>.

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c. Door Storage: [Glazed door without storage][Modular compartments][1 gal. milk-container storage]<Insert requirement>.
d. Temperature-controlled meat/deli bin.
e. <Insert feature>.

7. Freezer Features: One freezer compartment(s) [with door(s)][configured as pull-out drawer(s)].

a. Automatic defrost.
b. Interior light in freezer compartment.
c. Automatic icemaker and storage bin.
d. <Insert feature>.

8. Energy Star: Provide appliances that qualify for the EPA/DOE Energy Star product-labeling program.
9. Front Panel(s): Manufacturer's standard.

a. Panel Color: fingerprintless stainless.

10. Appliance Color/Finish: Stainless steel.

2.6 CLEANING APPLIANCES

A. Dishwasher: Complying with AHAM DW-1.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. GE Appliances; Haier Group

2. Type: Built-in undercounter.
3. Dimensions:

a. Width: 24 inches.
b. Depth: 23 inches As indicated on Drawings.
c. Height: 34-1/2 inches As indicated on Drawings.

4. Capacity:

a. International Place Settings of China: [Eight][12][14]<Insert number>.
b. Water Consumption for Full Load: [3.2 gal.]<Insert value> per cycle.

5. Sound Level: Maximum 42 dB.
6. Tub and Door Liner: [Manufacturer's standard][Porcelain-enameled steel][Stainless steel][Porcelain-enameled steel tub and molded-plastic door liner]<Insert requirement> with sealed detergent and automatic rinsing-aid dispensers.
7. Rack System: PVC -coated sliding dish racks, with removable cutlery basket.

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8. Controls: Touch-pad controls with [four]<Insert number> wash cycles and hot-air and heat-off drying cycle options.
9. Features:

    a. Waste food disposer.
    b. Self-cleaning food-filter system.
    c. Hot-water booster heater for 160 deg F wash water with incoming water at 100 deg F.
    d. Lock-out feature.
    e. Half-load option.
    f. Delay-wash option.
    g. Digital display panel.
    h. Water softener.
    i. Soil-sensing water use control system.
    j. <Insert feature>.

10. Energy Star: Provide appliances that qualify for the EPA/DOE Energy Star product-labeling program.
11. Front Panel: Manufacturer's standard.

    a. Panel Color: fingerprintless stainless.

12. Appliance Color/Finish: Stainless steel.

B. Clothes Washer: Complying with AHAM HLW-1.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. GE Appliances; Haier Group

2. Type: Freestanding, top -loading unit.
3. Dimensions:

    a. Width: 27 inches.
    b. Depth: 31 inches.
    c. Height: 45 inches.

4. Drum: Perforated stainless steel.

    a. Capacity: 5.4 cu. ft..

5. Controls: Touch-pad controls for water-fill levels, wash/rinse water temperatures, <Insert function,> and variable-speed and fabric selectors.

    a. Wash Cycles: [Four][Six][10]<Insert number> wash cycles, including regular, delicate, and permanent press.
    b. Wash Temperatures: [Three]<Insert number> settings.
    c. Speed Combinations: [Two][Four][Five].

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6. Electrical Power: As indicated on Drawings.
7. Motor: Manufacturer's standard with built-in overload protector.
8. Features:

    a. Agitator: Center spindle.
    b. Self-cleaning lint filter.
    c. Unbalanced-load compensator.
    d. Inlet Hoses: Minimum length 60 inches.
    e. Drain Hoses: Minimum length 48 inches.
    f. Self-leveling legs.
    g. Automatic dispenser for [bleach][fabric softener][and][detergent].
    h. Spin-cycle safety switch.
    i. End-of-cycle signal.
    j. Extra-rinse option.
    k. Delay-wash option.
    l. Electronic temperature control.
    m. Water levels automatically set.
    n. Pedestal: Manufacturer's standard height laundry pedestal with storage drawer, matching appliance finish.
    o. <Insert feature>.

9. Energy Star: Provide appliances that qualify for the EPA/DOE Energy Star product-labeling program.
10. Water-Efficient Clothes Washer: Provide clothes washer with modified energy factor greater than or equal to 2.0 and water factor less than 5.5.
11. Appliance Finish: Enamel.

    a. Color: diamond gray.

12. Front-Panel Finish: Manufacturer's standard.

    a. Panel Color: White.

C. Clothes Dryer: Complying with AHAM HLD-1.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. GE Appliances; Haier Group

2. Type: Freestanding, frontloading, electric unit.
3. Dimensions:

    a. Width: 27 inches.
    b. Depth: 31 inches.
    c. Height: As indicated on Drawings.

4. Drum: Perforated stainless steel.

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a. Capacity: 7.4 cu. ft..

5. Controls: Touch-pad controls for drying cycle, temperatures, <Insert function,> and fabric selectors.
6. Electric-Dryer Power: As indicated on Drawings.
7. Features:

a. Removable lint filter.
b. Electronic temperature and moisture-level-sensor controls.
c. End-of-cycle signal.
d. Interior drum light.
e. Self-leveling legs.
f. Antibacterial cycle.
g. Auxiliary drying rack.
h. Built-in electrical power fuse.
i. Stacking kit to stack dryer over washer.
j. Pedestal: Manufacturer's standard height laundry pedestal with storage drawer, matching appliance finish.
k. <Insert feature>.

8. Appliance Finish: Enamel.

a. Color: diamond gray.

9. Front-Panel Finish: Manufacturer's standard.

a. Panel Color: White.

2.7 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.

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C. Examine walls, ceilings, and roofs for suitable conditions where [overhead exhaust hoods][downdraft exhaust][and][microwave ovens with vented exhaust fans] will be installed.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 INSTALLATION OF RESIDENTIAL APPLIANCES

A. Install appliances according to manufacturer's written instructions.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

D. Range Anti-Tip Device: Install at each range according to manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections [with the assistance of a factory-authorized service representative]:

1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After installation, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

B. An appliance will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

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END OF SECTION 113013

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SECTION 115213 - PROJECTION SCREENS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manually operated, front-projection screens.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for metal support framing for front-projection screens.
2. Section 061000 "Rough Carpentry" for wood backing for screen installation.
3. Section 064023 "Interior Architectural Woodwork" for [wood trim][wood trim and wood ceiling closure panel] for recessed screen installation.
4. Section 115213.19 "Rear Projection Screens."

1.2 DEFINITIONS

A. ALR: Ambient-light rejection; for specular reflective viewing surfaces, measured as the percentage of ambient light striking the viewing surface that has equal angles of incidence and reflection.

B. Gain: Ratio of light reflected from viewing-surface material to that reflected perpendicularly from a magnesium carbonate surface as determined in accordance with SMPTE RP 94.

C. Half-Gain Angle: The angle, measured from the axis of the viewing surface to the most central position on a perpendicular plane through the horizontal centerline of the viewing surface, where the gain is half of the peak gain.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show layouts and types of front-projection screens. Include the following:

1. Drop heights.
2. Location of seams in viewing surfaces.
3. For end-mounted motors, location of screen centerline relative to ends of screen case.
4. Anchorage details, including connection to supporting structure for suspended units.

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5. Details of juncture of screen case or trim with adjacent finishes.
6. For electrically operated units, wiring diagrams and location of wiring connections.
7. Accessories.

C. Samples: For each type of exposed finish and for each color and finish specified, in manufacturer's standard sizes.

D. Samples for Initial Selection: For each type of exposed finish.

E. Samples for Verification: For each type of exposed finish, in manufacturer's standard sizes.

F. Product Schedule: For front-projection screens. [Use same designations indicated on Drawings.]

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For front-projection screens to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Environmental Limitations: Do not deliver front-projection screens until spaces are enclosed and weathertight, wet-work in installation spaces is complete and dry, and temporary or permanent HVAC system is operating and maintaining ambient temperature and humidity conditions planned for building occupants during the remainder of the construction period.

B. Store front-projection screens in manufacturer's protective packaging and according to manufacturer's written instructions.

1.6 COORDINATION

A. Coordinate layout and installation of front-projection screens with adjacent construction, including ceiling suspension systems, light fixtures, HVAC system components, [fire-suppression system,] and partitions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations for Projection Screens: Obtain [front-projection screens][each type of front-projection screen] from single manufacturer. Obtain viewing surfaces and accessories, including mounting hardware, from screen manufacturer.

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2.2 PERFORMANCE REQUIREMENTS

A. Viewing-Surface and Masking Materials:

1. Mildew-Resistance Rating: Zero or 1 when tested in accordance with ASTM G21.
2. Flame Resistance: Passes NFPA 701.
3. Flame-Spread Index: Not greater than 75 when tested in accordance with ASTM E84.

2.3 MANUALLY OPERATED, FRONT-PROJECTION SCREENS

A. General Requirements: Manufacturer's standard spring-roller-operated units, consisting of case, flexible screen, mounting accessories, and other components necessary for a complete installation.

1. Screen Mounting: Top edge securely anchored to a rigid steel roller; bottom edge formed into a pocket holding a tubular metal slat, with ends of slat protected by plastic caps, and with a saddle and pull attached to slat by screws.

B. Metal-Encased, Manually Operated Screen: Unit with free-hanging screen; with screen case fabricated from formed-steel sheet or aluminum extrusions with manufacturer's standard finish and matching end caps.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. Draper, Inc.
    b. Legrand AV Inc.; Legrand North America, LLC

2. Surface-Mounting Configuration: Mounted using manufacturer's standard projecting wall brackets.
3. Screen Case Color: As selected by Architect from manufacturer's standard options.
4. Matte Viewing Surface: White, 1.0 minimum peak gain and 60-degree minimum half-gain angle.
5. Viewing Surface: <Insert requirements>.
6. Seams: Where height of viewing surface exceeds maximum height without seams, locate horizontal seam with full-width material at bottom of viewing surface.
7. Edge Treatment: Without black masking borders.
8. Size of Viewing Surface: As indicated in schedule on Drawings.
9. Extra Drop Height: As indicated in schedule on Drawings.

    a. Color: Same as viewing surface.

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2.4 ELECTRICALLY OPERATED, FRONT-PROJECTION SCREENS

A. General Requirements: Manufacturer's standard units, consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation. [Provide units that are listed and labeled as an assembly by Underwriters Laboratories Inc. (UL) or another testing and inspecting agency acceptable to authorities having jurisdiction.]

1. 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. Screen Mounting: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a metal rod, with ends of rod protected by plastic caps.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install front-projection screens at locations indicated on Drawings to comply with screen manufacturer's written instructions.

B. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor them to supporting substrate in a manner that produces a smoothly operating screen that, when lowered, has flat viewing surface and plumb vertical edges.

1. Install low-voltage controls in accordance with NFPA 70 and complying with manufacturer's written instructions.

    a. Wiring Method: Install wiring in raceway, except in accessible ceiling spaces and in gypsum board partitions, where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables, except in unfinished spaces.

2. Test electrically operated units to verify that screen controls, limit switches, closures, and other operating components are in optimum functioning condition.
3. Test manually operated units to verify that screen-operating components are in optimum functioning condition.

END OF SECTION 115213

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SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manually operated, single-roller shades.

B. Related Requirements:

1. Section 057500 "Decorative Formed Metal" for shade pockets not provided by roller window shade manufacturer.
2. Section 061000 "Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
3. Section 079200 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.
4. Section 260010 "Supplemental Requirements for Electrical" for additional requirements applicable to coordinating, scheduling, and sequencing of the electrical Work specified in this Section.

1.2 ALLOWANCES

A. See Section 012100 "Allowances" for description of allowances affecting items specified in this Section.

1.3 ALTERNATES

A. See Section 012300 "Alternates" for description of alternates affecting items specified in this Section.

1.4 ACTION SUBMITTALS

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

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, [electrical characteristics,] features, and furnished accessories.

B. Shop Drawings:

1. Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

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2. Motor-Operated Shades: Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type and color of shadeband material and for each type of exposed finish.

1. Include Samples of accessories involving color selection.

D. Samples for Verification: Actual Sample of finished products for each type of roller shade including actual shadeband material and installation accessories.

1. Size: [Manufacturers' standard size]<Insert size>.

E. Product Schedule: For roller shades. [Use same designations indicated on Drawings.]

F. Sustainable Design Submittals:

1. Laboratory Test Reports: For product, indicating compliance with VOC emissions evaluation criteria.
2. Product Data for Cradle-to-Cradle Certification:

a. Confirming Cradle-to-Cradle certification under Version 3.1, 4, or 4.1 at Bronze level. Submittal must contain inventory assessment completed to at least 0.1 percent (1000 ppm) and certification expiration.
b. Confirming Cradle-to-Cradle certification under Version 3.1, 4, or 4.1 at Silver level or Material Health Silver Certificate. Submittal must contain inventory assessment completed to at least 0.01 percent (100 ppm) and certification expiration.
c. Confirming Cradle-to-Cradle certification under Version 3.1, 4, or 4.1 at Gold level or Material Health Gold Certificate. Submittal must contain inventory assessment completed to at least 0.01 percent (100 ppm) and certification expiration.

3. Product Data for Declare Certification:

a. Confirming Declare certification under Version 2. Submittal must contain inventory assessment completed to at least 0.1 percent (1000 ppm) and certification expiration date.
b. Confirming Declare certification Third-Party Verified and Red List Free or Red List Approved. Submittal must contain inventory assessment completed to at least 0.01 percent (100 ppm) and certification expiration date.

4. Product Data for Global Green Tag: Product Health Data (PhD) containing inventory assessment completed to at least 0.1 percent (1000 ppm) and certification expiration date.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of shadeband material.

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B. Product Test Reports: For each type of shadeband material, for tests performed by [a qualified testing agency][manufacturer and witnessed by a qualified testing agency].

C. Qualification Statements: For Installer.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials [, from the same production run,] to Owner 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 [3][5]<Insert number> percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than [two]<Insert number> units. Include mounting accessories.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

1.9 MOCKUPS

A. Install [one]<Insert number> of each type of roller window shade as a mockup to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 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.

1.11 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

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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.

1.12 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of products that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Defects in materials and workmanship beyond normal wear and tear.
b. Faulty operation of operating system components.
c. Deterioration of fabric beyond normal use.

2. Warranty Period:

a. Roller Window Shades: [Five][10][25]<Insert number> year(s) from date of Substantial Completion.
b. Motorized Components: [Five]<Insert number> year(s) from date of Substantial Completion.
c. Fabric: [Five][10][25]<Insert number> year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain roller shades from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Window Covering Safety Standard: Provide roller window shades that comply with WCMA A100.1 [and are listed and labeled as "Best for Kids" by a qualified testing agency].

B. Fire Performance: Tested in accordance with and meeting the flame propagation performance criteria of Test 1 or Test 2, as appropriate, of NFPA 701; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance

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with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.

1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:

    a. Drapery Operators: UL CCN FDDR, including UL 325.

D. Accessibility Standards: Comply with applicable provisions in [the USDOJ's "2010 ADA Standards for Accessible Design"][and][ICC A117.1]<Insert accessibility regulation> for roller window shades designated as accessible.

E. Laboratory Test Reports: For product, indicating compliance with VOC emissions evaluation criteria.

2.3 MANUALLY OPERATED ROLLER WINDOW SHADES

A. Manually Operated, Single-Roller Shades: For interior use in rectangular openings.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. Draper, Inc.
    b. Hunter Douglas Architectural Window Coverings
    c. Legrand Shading Systems; Legrand North America, LLC
    d. Levolor Inc.

2. 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.

    a. Roller Drive-End Location: Right side of interior face of shade.
    b. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
    c. Shadeband-to-Roller Attachment: Manufacturer's standard method.

3. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to six inline rollers into a multiband shade that is operated by one roller drive-end assembly.
4. Shadebands:

    a. Shadeband Material: Light-blocking fabric.
    b. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

        1) Type: Elliptical slat with endcaps, enclosed in open pocket of shadeband material.

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

5. Mounting Hardware: Brackets or endcaps, with endcap covers where exposed, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and installation location and conditions indicated.
6. Installation Accessories:

a. Front Fascia: Aluminum extrusion that conceals front and underside of roller and shadeband assembly and attaches to roller endcaps without exposed fasteners.

1) Shape: L-shaped.
2) Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 3 inches.

b. Exposed Headbox: Extruded-aluminum enclosure including front fascia, L-shaped top/back cover, and removable bottom closure, that fully conceals roller and shadeband assembly, and attaches to roller endcaps without exposed fasteners.

1) Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than 3 inches.

c. Recessed Shade Pocket:

1) U-shaped, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, and with removable bottom closure panel and end caps or plates. [Provide pocket with lip at lower edge to support acoustical ceiling panel.]

a) Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than [6 inches][5 inches][4 inches][height indicated on Drawings]<Insert dimension>.

2) As specified in Section 057500 "Decorative Formed Metal."

d. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.

1) Closure-Panel Width: [As indicated on Drawings][2 inches]<Insert dimension>.

e. Side Channels: Extruded aluminum "'U" channel with light seals, designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning

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shadebands with channels at tops.

f. Bottom (Sill) Channel or Angle: Extruded aluminum "U" channel or "L" angle with light seals, designed to eliminate light gaps at bottoms of shades when shades are closed.

g. Installation Accessories Color and Finish: [As selected from manufacturer's full range]<Insert color and finish>.

2.4 MANUAL OPERATION

A. Manual Corded Operation:

1. 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.

a. Bead Chains: Manufacturer's standard bead chain with WCMA A100.1 compliant tension device installed on roller window shade by manufacturer and mounted on jamb.

1) Loop Length: Full length of roller shade.
2) Limit Stops: Provide upper and lower ball stops.

b. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.

1) Provide for shadebands that weigh more than [10 lb]<Insert value> or for shades as recommended by manufacturer, whichever criterion is more stringent.

B. Manual Cordless Operation:

1. Crank-and-Gear Operating Mechanisms: Sealed gearbox drive system controlled by crank handle.

a. Crank-Handle Type: Permanently mounted.
b. Crank-Handle Length: Manufacturer's standard.

2.5 SHADEBAND MATERIALS

A. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

1. Source: [Roller shade manufacturer]<Insert source for custom fabrics>.
2. Type: Thermoplastic Olefin (TPO).
3. Weave: Mesh.
4. Thickness: <Insert thickness>.
5. Weight: <Insert oz./sq. yd.>.
6. Roll Width: [36 inches][48 inches][60 inches][72 inches][84 inches]<Insert dimension>.
7. Orientation on Shadeband: As indicated on Drawings.

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8. Openness Factor: [0.5][1][3][5][10][11][22]<Insert number> percent.
9. Color: As selected by Architect from manufacturer's full range.

B. Light-Blocking Fabric: Opaque fabric, stain and fade resistant.

1. Source: [Roller shade manufacturer]<Insert source for custom fabrics>.
2. Type: Woven 100 percent polyester.
3. Thickness: <Insert thickness>.
4. Weight: <Insert oz./sq. yd.>.
5. Roll Width: [36 inches][48 inches][60 inches][72 inches][84 inches]<Insert dimension>.
6. Orientation on Shadeband: As indicated on Drawings.
7. Features: [Washable][Antistatic treatment]<Insert requirements>.
8. Color: As selected by Architect from manufacturer's full range.

C. Acoustical Fabric: Woven fabric, stain and fade resistant.

1. Source: [Roller shade manufacturer]<Insert source for custom fabrics>.
2. Type: Thermoplastic Olefin (TPO).
3. Acoustical Performance: Sound absorption [NRC][or][SAA] of [0.60 to 0.70][0.50 to 0.60][0.40 to 0.50][0.30 to 0.40][0.20 to 0.30][not less than 0.50]<Insert range or single value> in accordance with ASTM C423 for Type G mounting in accordance with ASTM E795.
4. Thickness: [As required to meet acoustical performance]<Insert thickness>.
5. Weight: [As required to meet acoustical performance]<Insert oz./sq. yd.>.
6. Roll Width: [36 inches][48 inches][60 inches][72 inches][84 inches]<Insert dimension>.
7. Orientation on Shadeband: As indicated on Drawings.
8. Features: [Washable][Antistatic treatment]<Insert requirements>.
9. Openness Factor: [0.5][1][3][As required to meet acoustical performance]<Insert number> percent.
10. Color: As selected by Architect from manufacturer's full range.

2.6 FABRICATION OF ROLLER WINDOW SHADES

A. 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.
2. Outside of Jamb Installation: Width and length as indicated [in window-treatment schedule][on Drawings]<Insert requirements>, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

B. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:

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1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than [1:4]<Insert ratio>, 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. Skylight Shades: Provide battens and seams at uniform spacings along shadeband as required to ensure shadeband tracking and alignment through its full range of movement without distortion or sag of material.
3. 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, [locations of connections to building electrical system,] and other conditions affecting performance of the Work.

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

3.2 INSTALLATION OF ROLLER WINDOW SHADES

A. Install roller shades level, plumb, aligned and centered on openings, and aligned with adjacent units in accordance with manufacturer's written instructions.

1. Located so shadeband is not closer than [2 inches]<Insert dimension> to interior face of glass. Allow clearances for window operation hardware.

B. Roller Shade Locations: [At exterior windows][As indicated in window-treatment schedule][As indicated on Drawings]<Insert requirements>.

C. Motor-Operated Roller Window Shades: Electrical installation.

1. Connect motor-operated roller window shades to building electrical system.
2. Comply with manufacturer's written installation instructions.

3.3 ADJUSTING

A. Adjust and balance roller window shades to operate smoothly, easily, safely, and free from binding or malfunction through full operational range.

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3.4 CLEANING

A. Clean roller window shade surfaces, after installation, in accordance with manufacturer's written instructions.

B. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller window shades are without damage or deterioration at time of Substantial Completion.

B. Protect electrical [and communications] wiring, cabling, raceways, and boxes, after installation. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use, before time of substantial completion.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller window shades.

END OF SECTION 122413

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SECTION 123213 - MANUFACTURED WOOD-VENEER-FACED CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood-veneer-faced casework.
2. Hardware and accessories.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood blocking for anchoring casework.
2. Section 092216 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring casework.
3. Section 096513 "Resilient Base and Accessories" for resilient base applied to wood-veneer-faced casework.
4. Section 123553.19 "Wood Laboratory Casework."
5. Section 123619 "Wood Countertops."

1.2 DEFINITIONS

A. Definitions in the AWI/AWMAC/WI's "Architectural Woodwork Standards" apply to the Work of this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]<Insert location>.

B. Keying Conference: Conduct conference at [Project site]<Insert location>. Incorporate keying conference decisions into final keying requirements.

1.4 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.

1.5 ACTION SUBMITTALS

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

B. Shop Drawings: For wood-veneer-faced casework.

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1. Include plans, elevations, sections, and attachments to other work including blocking and reinforcements required for installation.
2. Indicate types and sizes of casework.
3. Indicate manufacturer's catalog numbers for casework.
4. Show fabrication details, including types and locations of hardware.
5. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and equipment.
6. Apply [AWI's Quality Certification][WI's Certified Compliance] Program label to Shop Drawings.

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 casework and hardware finishes.

E. Samples for Initial Selection: For casework and hardware finishes.

F. Samples for Verification: For the following:

1. Casework Finishes: 8-by-10-inch Samples for each type and color of finish.
2. Base Cabinet: One full-size, [16-inch-]<Insert dimension> wide, finished base cabinet complete with hardware, doors, and drawers but without countertop.
3. Wall Cabinet: One full-size, [12-inch-]<Insert dimension> wide, finished wall cabinet complete with hardware, doors, and adjustable shelves.
4. Full-Size Samples: Maintain at Project site during construction in an undisturbed condition as a standard for judging the completed Work. Unless otherwise indicated, approved sample units may become part of the completed Work if in undisturbed condition at time of Substantial Completion. Notify Architect of their locations.

G. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party-Certified Life-Cycle Assessment: For each product.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For [casework manufacturer][and][Installer].

B. Sample Warranty: For special warranty.

C. Field quality control reports.

1.7 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: [AWI's Quality Certification Program][WI's Certified Compliance Program] certificates.

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1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish complete touchup kit for each casework finish provided. Include fillers, stains, finishes, and other materials necessary to perform permanent repairs to damaged casework finish.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: [An authorized representative who is trained and approved by manufacturer][and][licensed participate in AWI's Quality Certification Program][licensed participate in WI's Certified Compliance Program].

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

1.11 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 levels planned for building occupants during remainder of construction period. [Maintain temperature and relative humidity during remainder of construction period in range recommended for Project location by the AWI/AWMAC/WI's "Architectural Woodwork Standards."]

B. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

C. Field Measurements: Where casework is indicated to fit to existing construction, verify dimensions of existing construction by field measurements before fabrication and indicate measurements on Shop Drawings. Provide fillers and scribes to allow for trimming and fitting.

D. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before enclosing them, and indicate measurements on Shop Drawings.

1.12 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.

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b. Warping of components.
c. Failure of operating hardware.
d. Deterioration of finishes.

2. Warranty Period: [Five]<Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain manufactured wood-veneer-faced casework from single source from single manufacturer.

2.2 GENERAL REQUIREMENTS FOR CASEWORK

A. Quality Standard: Unless otherwise indicated, comply with the AWI/AWMAC/WI's "Architectural Woodwork Standards" for grades of casework indicated for construction, finishes, installation, and other requirements.

1. Grade: [Premium][Custom][Economy].
2. Provide labels and certificates from [AWI][WI] certification program indicating that casework complies with requirements of grades specified.

a. This Project has been registered with AWI as AWI's Quality Certification Program Number <Insert number>.
b. Contractor to register the Work under this Section with the AWI Quality Certification Program at www.awiqcp.org or by calling 855-345-0991.

B. Product Designations:

1. Drawings indicate sizes, configurations, and finish materials of manufactured wood-veneer-faced casework by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes and door and drawer configurations, of same finish materials, and complying with the Specifications may be considered. See Section 016000 "Product Requirements."
2. Drawings indicate configurations of manufactured wood-veneer-faced casework by referencing designations of Casework Design Series numbering system in the Appendix of the AWI/AWMAC/WI's "Architectural Woodwork Standards."

2.3 WOOD-VENEER-FACED CASEWORK

A. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

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1. Kewaunee Scientific Corporation
2. TMI Systems Corporation

B. Design: Face-frame cabinet construction with the following door and drawer-front style:

1. Lipped overlay with radiused wood edges [and full-width, recessed finger pulls machined into faces of doors and drawers].
2. Reveal overlay [with recessed finger pulls machined into faces of doors and drawers].
3. Flush overlay.

C. Wood Species: White maple.

1. Wood Stain Colors and Finishes: As selected by Architect from casework manufacturer's full range.

D. Face Veneer Cut: Plain sliced.

E. Veneer Matching:

1. None required; select and arrange veneers for compatible grain and color.
2. Provide veneers for each cabinet from a single flitch, book and balance matched.

    a. Provide continuous matching of adjacent drawer fronts within each cabinet.

3. Provide veneers for each elevation from a single flitch, [book and running][slip and running][book or slip and running][book and balance][slip and balance][book or slip and balance] matched.

    a. Provide continuous matching of adjacent drawer fronts within each cabinet and end matching between drawer fronts of adjacent cabinets.

F. Grain Direction:

1. Doors: Vertical with continuous vertical matching.
2. Drawer Fronts: [Vertical with continuous vertical matching][Horizontal].
3. Face Frame Members: Lengthwise.
4. End Panels: Vertical.
5. Bottoms and Tops of Units: Side to side.
6. Knee Space Panels: Vertical.
7. Aprons: Horizontal.

G. Exposed Materials:

1. Plywood: Hardwood plywood with face veneer of species indicated, selected for compatible color and grain. Provide backs of same species as faces.
2. Solid Wood: Clear hardwood lumber of species indicated and selected for grain and color compatible with exposed plywood.
3. Edgebanding: Wood veneer of same species as face veneer.

    a. PVC Edgebanding Color: As selected by Architect from casework

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manufacturer's full range.

H. Semiexposed Materials:

1. Wood: Provide solid wood or hardwood plywood for semiexposed surfaces unless otherwise indicated.

   a. Solid Wood: Sound hardwood lumber, selected to eliminate appearance defects, of same species as exposed wood.
   b. Plywood: Hardwood plywood of same species as exposed wood. Provide backs of same species as faces.

2. Thermally Fused Laminate (TFL) Panels: Provide thermally fused laminate panels for semiexposed surfaces, except provide solid wood or hardwood plywood for interior faces of doors and drawer fronts and other locations where opposite side of component is exposed.

   a. Colors and Patterns: As selected by Architect from manufacturer's full range.

3. Hardboard: Use only for cabinet backs where exterior side of back is not exposed.
4. Metal for Steel Drawer Pans: Cold-rolled, carbon-steel sheet complying with ASTM A1008/A1008M; matte finish; suitable for exposed applications.

I. Concealed Materials:

1. Solid Wood: With no defects affecting strength or utility.
2. Plywood: Hardwood plywood. Provide backs of same species as faces.
3. Particleboard.
4. MDF.
5. Hardboard.

2.4 HARDWARE AND ACCESSORIES

A. Hardware: 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. Butt Hinges: Stainless steel, semiconcealed, five-knuckle hinges complying with ANSI/BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide two hinges for doors less than 48 inches high, and provide three hinges for doors more than 48 inches high.

C. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, Type B01602 [, self-closing]. Provide two hinges for doors less than 48 inches high, and provide three hinges for doors more than 48 inches high.

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1. Degrees of Opening: 170 degrees.

D. Wire Pulls: Solid stainless steel wire pulls, fastened from back with two screws.

1. For sliding doors, provide recessed stainless steel flush pulls.
2. Provide two pulls for drawers more than 24 inches wide.

E. Semirecessed Pulls: Plastic. For sliding doors, provide recessed plastic flush-pulls. Provide two pulls for drawers more than 24 inches wide.

F. Door Catches: Powder-coated, dual, self-aligning, permanent magnet catch. Provide two catches on doors more than 48 inches high.

G. Door and Drawer Bumpers: Self-adhering, clear silicone rubber.

1. Doors: Provide one bumper at top and bottom of closing edge of each swinging door.
2. Drawers: Provide one bumper on back side of drawer front at each corner.

H. Drawer Slides: ANSI/BHMA A156.9.

1. Manufacturer's standard.
2. Standard Duty (Grade 1): Undermount.
3. Heavy Duty (Grade 1HD-100): Undermount.

a. Type: Full extension.
b. Material: Zinc-plated ball bearing slides.
c. Motion Feature: Soft close dampener.

4. General-purpose drawers; provide [100 lb]<Insert weight> load capacity.
5. File drawers; provide [150 lb]<Insert weight> load capacity.

I. Label Holders: [Stainless steel][or][chrome plated], sized to receive standard label cards approximately 1 by 2 inches, and attached with screws or brads.

1. Provide label holders [where indicated][on drawers].

J. Drawer and Hinged-Door Locks: [Cylindrical (cam)][Mortise] type, five-pin tumbler, brass with chrome-plated finish, and complying with ANSI/BHMA A156.11, Grade 1.

1. Provide a minimum of two keys per lock and six master keys.
2. Provide locks [where indicated][on every door and drawer].

a. Master key for up to [500]<Insert number> key changes.

K. Sliding-Door Hardware Sets: Manufacturer's standard, to suit type and size of sliding-door unit.

L. Adjustable Shelf Supports:

1. Pin-type, single-pin metal shelf rests complying with ANSI/BHMA A156.9, Type

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B04013.

2. Mortise-type, [zinc-plated][powder-coated] steel standards and shelf rests complying with ANSI/BHMA A156.9, Type B04071 and Type B04091.

2.5 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.

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent.

E. MDF: Medium-density fiberboard, ANSI A208.2, [Grade 130]<Insert grade>.

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent.

F. Hardboard: ANSI A135.4, Class 1 tempered.

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent.

G. PVC Edgebanding for Wood: Rigid PVC extrusions, through color with satin finish, 3.0 mm thick at doors and drawer fronts, 1.0 mm thick elsewhere.

H. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper [and complying with requirements of ISO 4586].

1. Edgebanding for Thermally Fused Laminate (TFL) Panels: PVC or polyester edgebanding matching thermally fused laminate panels.

I. Glass for Glazed Doors:

1. Clear float glass complying with ASTM C1036, Type I, Class 1, Quality-Q3; not less than [3.0 mm][4.0 mm][5.0 mm][6.0 mm] thick.
2. Clear tempered glass complying with ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality-Q3; not less than 5.0 mm thick.
3. Clear laminated annealed glass complying with ASTM C1172, Kind LA, Condition A, Type I, Class I, Quality-Q3; with two plies not less than 3.0 mm thick and with clear, polyvinyl butyral interlayer.

J. Frameless Glass Doors: Clear tempered glass complying with ASTM C1048, Kind FT,

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Condition A, Type I, Class 1, Quality-Q3; not less than [5.0 mm][6.0 mm] thick; with exposed edges seamed before tempering.

2.6 FABRICATION

A. Wood-Veneer-Faced Cabinet Construction: As required by referenced quality standard, but not less than the following:

1. Bottoms of Cabinets and Tops of Wall Cabinets: 3/4-inch- thick, [veneer-core] hardwood plywood.
2. Ends of Cabinets: 3/4-inch- thick, hardwood plywood.
3. Shelves: 3/4-inch- thick, veneer-core hardwood plywood or 1-inch- thick, particleboard-core hardwood plywood.
4. Base Cabinet Top Frames: 3/4-by-2-inch solid wood with mortise and tenon or doweled connections, glued and pinned or screwed.
5. Base Cabinet Stretchers: 3/4-by-4-1/2-inch plywood, particleboard, or MDF strips or solid-wood boards at front and back of cabinet, glued and pinned or screwed. [May be provided as an option to base cabinet top frames.]
6. Base Cabinet Subtops: 3/4-inch- thick panel product, glued and pinned or screwed. [May be provided as an option to base cabinet top frames.]
7. Backs of Cabinets: 3/4-inch- thick, particleboard-core hardwood plywood where exposed, [1/4-inch- thick hardboard][1/4-inch- thick, veneer-core hardwood plywood][1/2-inch- thick hardwood plywood], dadoed into sides, bottoms, and tops where not exposed.
8. Drawer Fronts: 3/4-inch- thick, particleboard-core hardwood plywood or solid hardwood.
9. Drawer Sides and Backs: 1/2-inch- thick, solid-wood or [veneer-core] hardwood plywood, with glued dovetail or multiple-dowel joints.
10. Drawer Bottoms: 1/4-inch- thick, veneer-core hardwood plywood, glued and dadoed into front, back, and sides of drawers. [Use 1/2-inch- thick material for drawers more than 24 inches wide.]
11. Drawer Bodies: Steel drawer pans formed from 0.036-inch- thick metal, metallic phosphate treated, and finished with manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat with a minimum dry film thickness of 1 mil for topcoat and 2 mils for system.
12. Cabinet Doors:

    a. 48 Inches (1220 mm) or Less in Height: 3/4 inch thick, with [solid hardwood stiles and rails,] particleboard or MDF cores, and hardwood face veneers and crossbands.
    b. 48 Inches (1220 mm) or More in Height: [1-1/16 inches thick, with solid hardwood stiles and rails, honeycomb cores,][1-1/8 inches thick, with particleboard cores] and hardwood face veneers and crossbands.

B. Filler Strips: Provide as needed to close spaces between casework and walls, ceilings, and equipment. Fabricate from same material and with same finish as casework.

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2.7 FINISH

A. Preparation: Sand lumber and plywood before assembling. Sand edges of doors and drawer fronts and molded shapes with profile-edge sander. Sand casework after assembling for uniform smoothness at least equivalent to that produced by 220-grit sanding and without machine marks, cross sanding, or other surface blemishes.

B. Staining: Remove fibers and dust and apply wash-coat sealer and stain to exposed and semiexposed surfaces as required to provide uniform color and to match approved Samples.

C. Finishing Closed-Grain Woods: Apply manufacturer's standard two-coat, baked, clear finish consisting of a thermosetting catalyzed sealer and a thermosetting catalyzed conversion varnish. Sand and wipe clean between applications of sealer and topcoat. Topcoat may be omitted on concealed surfaces.

D. Finishing Open-Grain Woods: Apply manufacturer's standard three-coat, baked, clear finish consisting of a thermosetting catalyzed sealer and two coats of a thermosetting catalyzed conversion varnish. Sand and wipe clean between applications of sealer and topcoat and between topcoats. Topcoats may be omitted on concealed surfaces.

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 INSTALLATION

A. Grade: Install casework to comply with same quality standard grade as item to be installed.

B. Install casework level, plumb, and true in line; 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 cabinets to hanging strips, masonry, framing, wood blocking, or reinforcements in walls and partitions. Align similar adjoining doors to a tolerance of 1/16 inch.

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E. Fasten casework to adjacent units and to masonry, framing, wood blocking, or reinforcements in walls and partitions to comply with the AWI/AWMAC/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 operating hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.3 FIELD QUALITY CONTROL

A. Inspections: Provide inspection of installed Work through [AWI's Quality Certification Program][WI's Certified Compliance Program] certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.

1. Inspection entity to prepare and submit report of inspection.

3.4 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 123213

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SECTION 123661 - SIMULATED STONE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quartz agglomerate countertops.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for cantilever supports.
2. Section 224100 "Residential Plumbing Fixtures" and Section 224200 "Commercial Plumbing Fixtures" for non-integral sinks and plumbing fittings.

1.2 ACTION SUBMITTALS

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

B. Shop Drawings:

1. Plans, sections, details, edge and backsplash profiles, and attachment to other work.
2. Locations and details of joints.
3. Locations, quantity, and type of supports/brackets.
4. Direction of directional pattern, if any.
5. Locations and sizes of cutouts and holes for items installed in countertop.
6. Apply [AWI's Quality Certification][WI's Certified Compliance] Program label to Shop Drawings.

C. Samples for Initial Selection: For each type of material exposed to view.

D. Samples for Verification:

1. Countertop material, 6 inches square.
2. One full-size countertop, with front edge [and backsplash], 8 by 10 inches, of construction and in configuration specified.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Indicate locations and sizes of cutouts and holes for items installed in countertops or backsplashes.

B. Qualification Statements: For fabricator.

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1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface countertops to include in maintenance manuals. Include product data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

1. Fabricator to perform installation of countertops.

1.6 MOCKUPS

A. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.

1. Build mockup of typical countertop as indicated on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.

B. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

C. Keep surfaces of countertops covered with protective covering during handling and installation.

1.8 FIELD CONDITIONS

A. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of countertops by field measurements [after base cabinets are installed but] before countertop fabrication is complete and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work..

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Quality Standard: Unless otherwise indicated, comply with [ANSI/AWI 1236][NAAWS] for grades of simulated stone countertops indicated for construction, finishes, installation, and other requirements.

1. Provide inspections of fabrication and installation together with labels and certificates from [AWI][WI] certification program indicating that countertops comply with requirements of grade specified.
2. The Contract Documents contain more stringent requirements than that of the referenced quality standard. Comply with requirements of the Contract Documents in addition to those of referenced quality standard.

2.2 SIMULATED STONE COUNTERTOPS

A. Quartz Agglomerate Countertops:

1. Manufacturers: Subject to compliance with requirements, [provide products by the following][provide products by one of the following][available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. Cambria
    b. TechniStone; Wilsonart LLC

2. Quartz Agglomerate Material: Homogenous fabrication of natural quartz aggregates and pigments bound together with a matrix of polymers and resins, complying with ISFA 3-01.

    a. Thickness: 1.18 inch.
    b. Colors and Patterns: As selected by Architect from manufacturer's full range.

3. Countertop Grade: Premium.
4. Countertop Construction:

    a. Exposed Edge Treatment: As selected by Architect from manufacturer's full range.
    b. Provide drip groove [1/8 inch by 1/8 inch set back 3/8 inch]<Insert groove size and location> from front edge of countertop.
    c. Backsplash: Detached straight.

        1) Height: [4 inches]<Insert height>.

    d. End Splash: Matching backsplash.
    e. Sink Bowls: Under-counter mounted.

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2.3 ACCESSORIES

A. Sink Bowl : [Top mounted][Under-counter mounted].

1. Material: [PMMA][Acrylic][Composite][Enameled cast iron][Enameled steel][Solid surface][Stainless steel][Vitreous china]<Insert type>.
2. Shape: [Oval][Rectangle]<Insert type>.
3. Color: [White][Match countertop]<Insert color>.

B. Countertop Support Brackets :

1. Type: [Hidden][Front mount][Decorative].so
2. Style: <Insert manufacturer and model number>.
3. Material: [Steel][Stainless steel][Bronze][Iron].
4. Color: [Black][White] powder coat.

2.4 FABRICATION

A. Fabricate countertops in sizes and shapes required to comply with requirements indicated on Drawings.

B. Fabricate tops with shop-applied edges [and backsplashes] unless otherwise indicated. Comply with countertop material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.
2. Install integral sink bowls in countertops in the shop.

C. Joints:

1. Fabricate countertops without joints.
2. Fabricate countertops in sections for joining in field [, with joints at locations indicated on Drawings].

a. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
b. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints [where indicated on Drawings]. Make width of cuts slightly more than thickness of splines to provide snug fit. [Provide at least three splines in each joint.]

D. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures [in shop] using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture

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opening.

b. Provide vertical edges, rounded to 3/8-inch radius at juncture of cutout edges with top surface of countertop, slightly eased at bottom, and projecting 3/16 inch into fixture opening.
c. Provide 3/4-inch full bullnose edges projecting 3/8 inch into fixture opening.

2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
3. Fittings: Drill countertops in shop for grommets, plumbing fittings, undercounter soap dispensers, and similar items.
4. Counter-Mounted Cooktops: Prepare countertops in shop for field cutting openings for cooktops. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.

2.5 INSTALLATION MATERIALS

A. Particleboard: ANSI A208.1, [Grade M-2][Grade M-2-Exterior Glue].

B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

C. Adhesive: Product recommended in writing by countertop material manufacturer.

D. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

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

3.2 PREPARATION

A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

B. Examine shop-fabricated work for completion and complete work as required, including removal of packing materials.

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3.3 INSTALLATION OF SIMULATED STONE COUNTERTOPS

A. Grade: Install countertops to comply with specified grade.

B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.

1. Provide cutouts not finished in the shop. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

C. Countertop Installation:

1. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
3. Anchor wall cleating necessary for proper setting for countertops not supported by casework.
4. Install countertops level to a tolerance of 1/8 inch in 8 ft., 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
5. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by countertop material manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with countertop material manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
6. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
7. Secure countertops to subtops with adhesive in accordance with countertop material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with countertop material manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
8. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

    a. Install metal splines in kerfs in countertop edges at joints [where indicated on Drawings]. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
    b. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

9. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
10. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended in writing by manufacturer.

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11. Seal joints between countertop and backsplash, if any, and joints where countertop and backsplash abut walls. Comply with Section 079200 "Joint Sealants."

3.4 ADJUSTING

A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.

3.5 CLEANING

A. Clean countertops on exposed and semi-exposed surfaces.

3.6 PROTECTION

A. Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION 123661

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SECTION 124813 - ENTRANCE FLOOR MATS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. [Recessed][Surface-mounted] frames.

B. Related Requirements:

1. Section 124816 "Entrance Floor Grilles" for rigid floor grilles and frames.

1.2 COORDINATION

A. Coordinate size and location of recesses in concrete to receive floor mats and frames.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for floor mats and frames.

B. Shop Drawings:

1. Items penetrating floor mats and frames, including door control devices.
2. Divisions between mat sections.
3. Perimeter floor [moldings][frames].
4. Custom Graphics: Scale drawing indicating colors.

C. Samples: For the following products, in manufacturer's standard sizes:

1. Floor Mat: Assembled sections of floor mat.
2. Tread Rail: Sample of each type and color.
3. Frame Members: Sample of each type and color.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For floor mats and frames to include in maintenance manuals.

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1.5 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.

PART 2 - PRODUCTS

2.1 ENTRANCE FLOOR MATS AND FRAMES, GENERAL

A. Structural Performance: Provide roll-up rail mats and frames capable of withstanding the following loads and stresses within limits and under conditions indicated:

1. Uniform floor load of [300 lbf/sq. ft.]<Insert value>.
2. Wheel load of [350 lb]<Insert value> per wheel.

B. Accessibility Standard: Comply with applicable provisions in [the DOJ's "2010 ADA Standards for Accessible Design"][and][ICC A117.1]<Insert regulation>.

2.2 FRAMES

A. Recessed Frames: Manufacturer's standard extrusion.

1. Extruded Aluminum: ASTM B221, Alloy 6061-T6 or Alloy 6063-T5, T6, or T52.

a. Color: As selected by Architect from full range of industry colors and color densities.

2. Architectural Bronze: ASTM B455, Alloy UNS No. C38500.

B. Surface-Mounted Frames:

2.3 CONCRETE FILL AND GROUT MATERIALS

A. Provide concrete fill and grout equivalent in strength to cast-in-place concrete slabs for recessed mats and frames. Use aggregate no larger than one-third fill thickness.

2.4 FABRICATION

A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

B. Recessed Frames: As indicated, for permanent recessed installation, complete with

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corner pins or reinforcement and anchorage devices.

1. Fabricate edge-frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

C. Surface-Mounted Frames: As indicated for permanent surface-mounted installation, complete with corner connectors, splice plates or connecting pins, and postinstalled expansion anchors.

D. Coat concealed surfaces of aluminum frames that contact cementitious material with manufacturer's standard protective coating.

2.5 ALUMINUM FINISHES

A. Mill finish.

B. Clear Anodic Finish: AAMA 611, [AA-M12C22A41, Class I, 0.018 mm][AA-M12C22A31, Class II, 0.010 mm] or thicker.

C. Color Anodic Finish: AAMA 611, [AA-M12C22A42/A44, Class I, 0.018 mm][AA-M12C22A32/A34, Class II, 0.010 mm] or thicker.

2.6 Carpet-Type Mats

A. Basis-of-Design Product: Subject to compliance with requirements, provide <Insert manufacturer's name; product name or designation> or comparable product by one of the following:

1. [Matter Surfaces]
2. [van Gelder, Inc]
3. <Insert manufacturer's name>

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and floor conditions for compliance with requirements for location, sizes, [minimum recess depth,] and other conditions affecting installation of floor mats and frames.

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

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3.2 INSTALLATION

A. Install recessed mat frames and mats to comply with manufacturer's written instructions so that tops of mats will be flush with adjoining finished flooring. Set mats with tops at height recommended by manufacturer for most effective cleaning action; coordinate tops of mat surfaces with bottoms of doors that swing across mats to provide clearance between door and mat.

1. For installation in terrazzo flooring areas, allow for grinding and polishing of terrazzo without grinding surface of recessed frames. Coordinate with other trades as required.
2. Install necessary shims, spacers, and anchorages for proper location, and secure attachment of frames.
3. Install grout and fill around frames and, if required to set mat tops at proper elevations, in recesses under mats. Finish grout and fill smooth and level.
4. Delay setting mats until construction traffic has ended.

B. Install surface-type units to comply with manufacturer's written instructions; coordinate with entrance locations and traffic patterns.

1. Anchor fixed surface-type frame members to floor with devices spaced as recommended by manufacturer.

3.3 PROTECTION

A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION 124813

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SECTION 142113 - ELECTRIC TRACTION FREIGHT ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
2. Section 042000 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
3. Section 051200 "Structural Steel Framing" for the following:

    a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
    b. Divider beams.
    c. Hoist beams.
    d. Structural-steel shapes for [subsills][and][hoistway door frames] that are part of steel frame.

4. Section 055000 "Metal Fabrications" for the following:

    a. Attachment plates and angle brackets for supporting guide-rail brackets.
    b. Divider beams.
    c. Hoist beams.
    d. Structural-steel shapes for [subsills][and][hoistway door frames].
    e. Pit ladders.
    f. Cants made from steel sheet in hoistways.

5. Section 055213 "Pipe and Tube Railings" for railings between adjacent elevator pits.
6. Section 099123 "Interior Painting" for field painting of hoistway entrance doors and frames.
7. Section 102213 "Wire Mesh Partitions" for guards between adjacent elevator pits.
8. Section 271513 "Communications Copper Horizontal Cabling" for twisted pair conductor telephone service for elevators [and for Internet connection to elevator controllers for remote monitoring of elevator performance].
9. [Section 284621.11 "Addressable Fire-Alarm Systems"][Section 284621.13 "Conventional Fire-Alarm Systems"] for smoke detectors in elevator lobbies to initiate emergency recall operation [and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation] and for connection to elevator controllers.

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1.2 DEFINITIONS

A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information.

B. Shop Drawings:

1. Include plans, elevations, sections, and large-scale details indicating service at each landing, [machine room layout,] coordination with building structure, relationships with other construction, and locations of equipment.
2. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

C. Samples for Initial Selection: For finishes involving color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and [machine room][control closet] layout and dimensions, as shown on Drawings, and electrical service [including standby power generator], as shown and specified, are adequate for elevator system being provided.

D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

1. Submit manufacturer's/installer's standard operation and maintenance manual, according to ASME A17.1 [including diagnostic and repair information available to manufacturer's and Installer's maintenance personnel].

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B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard [one-year][two-year][five-year]<Insert agreement period> maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

D. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner with terms, conditions, and obligations as set forth in, and in same form as, "Draft of Elevator Maintenance Agreement" at end of this Section, starting on date initial maintenance service is concluded.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer [or an authorized representative who is trained and approved by manufacturer].

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.8 COORDINATION

A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

B. Coordinate locations and dimensions of other work relating to electric traction freight elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

1.9 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace elevator work that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

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2. Warranty Period: <Insert number> year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

B. Accessibility Requirements: Comply with Section 407 in the United States Access Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.

C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7]<Insert requirement> and shall comply with elevator seismic requirements in ASME A17.1/CSA B44.

1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified [and the system will be fully operational after the seismic event]."
2. Project Seismic Design Category: [C][D][E][F].
3. Elevator Component Importance Factor: [1.5][1.0].
4. Design earthquake spectral response acceleration short period (Sds) for Project is <Insert value>.
5. Provide earthquake equipment required by ASME A17.1/CSA B44.
6. Provide seismic switch required by ASCE/SEI 7.

2.2 FREIGHT ELEVATORS

A. Elevator System, General: Manufacturer's standard electric traction freight elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.

B. Elevator Description:

1. Elevator Number(s): E-2 as shown on Drawings.
2. Elevator Type: Geared traction.
3. Machine Location: Hoistway; no machine room is provided.
4. Rated Load: 5000 lb.
5. Freight Loading Class: [Class A][Class B][Class C1][Class C2][Class C3].
6. Rated Speed: 100 fpm 150 fpm.
7. Operation System: Single automatic.
8. Auxiliary Operations:

    a. Standby power operation.
    b. Battery-powered automatic evacuation.
    c. Earthquake Emergency Operation: Comply with requirements in ASME A17.1/CSA B44.
    d. Load-weighing device.

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9. Security Feature: [Card-reader][Keyswitch] operation.
10. Auxiliary Car-Control Station: Provide additional car-control station mounted on side of car at height to facilitate operation by forklift-truck operator without leaving truck.
11. Car Enclosures:

    a. Platform Width: 64 inches.
    b. Platform Depth: 84 inches.
    c. Ceiling Height: 84 inches.
    d. Walls and Ceiling: Prime-painted or powder-coated, metallic-coated steel.
    e. Car Fixtures: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
    f. Floor: Rolled steel floor plate.
    g. Car Gate Type: Vertical biparting.
    h. Car Gate Operation: Power operated.
    i. Car Gate Material: Prime-painted or powder-coated steel.
    j. Car Sill: Steel angle.
    k. Lighting:

        1) Two 48-inch, [suspended,][surface-mounted,] two-tube fluorescent light fixture(s) with [white reflectors][and][wire lamp guards].
        2) Two 48-inch, recessed, two -tube fluorescent light fixture(s) with UV-stabilized acrylic diffusers not less than 0.125 inch thick.

12. Hoistway Entrances:

    a. Width: 56 inches.
    b. Height: 84 inches.
    c. Door Type: Vertical biparting.
    d. Fire-Protection Rating: 1 hour.
    e. Door Operation: .
    f. Door Material: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
    g. Door Frame Material: Satin stainless steel, ASTM A480/A480M, No. 4 finish.

13. Hall Fixtures: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
14. Auxiliary Hall Stations: Provide additional pendant-mounted, hall push-button stations [where indicated], mounted at height to facilitate operation by forklift-truck operator without leaving truck.

2.3 TRACTION SYSTEMS

A. Elevator Machines: Variable-voltage, variable-frequency, ac-type hoisting machines [or variable-voltage dc-type hoisting machines] and solid-state power converters.

1. Provide [regenerative][or][nonregenerative] system.
2. Provide regenerative system that complies with IgCC.
3. Limit total harmonic distortion of regenerated power to 5 percent per IEEE 519.
4. Provide means for absorbing regenerated power when elevator system is operating on standby power.
5. Provide line filters or chokes to prevent electrical peaks or spikes from feeding

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back into building power system from solid-state converters.

B. Fluid for Hydraulic Buffers: If using hydraulic buffers, use only fire-resistant fluid.

C. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.

D. Machine Beams: Provide framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Section 055000 "Metal Fabrications" for materials and fabrication.

E. Car Frame and Platform: Welded [or bolted] -steel units.

1. Provide special heavy-duty units where indicated for power truck loading, designed to withstand impacts and wheel loadings indicated.

2.4 OPERATION SYSTEMS

A. Provide manufacturer's standard microprocessor operation systems as required to provide type of operation indicated.

B. Single-Car Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power by a switch in control panel located at [main lobby][fire command station]<Insert location>.

C. Single-Car Battery-Powered Automatic Evacuation: If power fails and car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it moves to the next floor above or below, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.

D. Group Standby Power Operation: On activation of standby power, cars are returned one car at a time to a designated floor and parked with doors open. If a car cannot be returned, it is removed from the system. One car is selected for service on standby power by a switch in the control panel located at [main lobby][fire command station]<Insert location>.

E. Group Battery-Powered Automatic Evacuation: If power fails, cars that are at a floor remain at that floor, open their doors, and shut down. Cars that are between floors are moved one at a time to the next floor above or below, open their doors, and shut down. System includes rechargeable battery and automatic recharging system.

F. Load-Weighing Device: When car load exceeds 80 percent of rated capacity, a signal lamp lights and remains lit in the car-control station; when car load exceeds rated capacity, car does not respond to car or hall calls.

G. Security Features: Security features shall not affect emergency firefighters' service.

1. Card-Reader Operation: System uses card readers at [car-control

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stations][and][hall push-button stations] to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. [Allow space as indicated for card reader in car][Provide stripe-swipe card reader integral with each car-control station].

a. Security access system equipment is [specified in Section 281500 "Access Control Hardware Devices."][not in the Contract.]

2. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at [car-control stations][and][hall push-button stations]. Key is removable [only in deactivated position][in either position].

2.5 DOOR REOPENING DEVICES

A. Infrared Array: Provide door reopening device with a uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.

2.6 CAR ENCLOSURES

A. Provide car enclosures as indicated, including ventilation, lighting, finishes, access doors, thresholds, trim, and accessories. Fabricate with recesses and cutouts for signal equipment.

1. Provide power door operators with linkages for hoistway door operation.
2. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.

B. Materials and Fabrication: Provide manufacturer's standard, flush panel, welded construction made from metal sheet, of metal indicated, not less than 0.067 inch and reinforced at 16-inch maximum spacing.

1. Provide perforated panels for ceiling and for walls above 72 inches from car floor, unless required to be solid by ASME A17.1/CSA B44.

C. <Insert requirements>.

2.7 HOISTWAY ENTRANCES

A. Unless otherwise indicated, provide hoistway entrance doors of type indicated below, with truckable sill bars and resilient safety meeting-rail gaskets.

1. Equip for power operation by coordinated linkage with power-operated car door.
2. Where gypsum board wall construction is indicated, provide fire-resistance-rated, hollow-metal, door-and-frame hoistway entrances. Provide self-supporting frames with reinforced head sections.

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B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close-to-neutral pressure as possible according to [NFPA 252][or][UL 10B].

C. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:

1. Metal Door Panels: Constructed of metal sheets, flush on room side, welded and reinforced in steel framing with vertical reinforcing spaced not more than 24 inches o.c. Fabricate panel faces from metal sheet, of metal indicated, not less than 0.097 inch thick.

2.8 SIGNAL EQUIPMENT

A. Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements of acrylic or other permanent, non-yellowing translucent plastic.

B. Car-Control Stations: Provide manufacturer's standard car-control station. Mount adjacent to car door unless otherwise indicated.

1. Mark buttons and switches for function. Use both tactile symbols and Braille.
2. Mount controls at heights complying with the United States Access Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.

C. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

D. Firefighters' Two-Way Telephone Communication Service: Provide [flush-mounted cabinet][telephone jack] in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in [Section 284621.11 " Addressable Fire-Alarm Systems."][Section 284621.13 "Conventional Fire-Alarm Systems."]

E. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station.

F. Hall Push-Button Stations: Provide hall push-button station at each landing as indicated.

1. Provide single-button stations with [position]["in-use"] indicator.

G. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in [Section 284621.11 "Addressable Fire-Alarm Systems."][Section 284621.13 "Conventional Fire-Alarm Systems."]

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2.9 FINISH MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, commercial steel, Type B, exposed, matte finish.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, commercial steel, Type B, pickled.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, commercial steel, with G60 zinc coating (galvanized) or A60 zinc-iron-alloy coating (galvannealed).

D. Stainless Steel Sheet: ASTM A240/A240M, Type 304.

E. Textured Stainless Steel Sheet: ASTM A240/A240M, Type 304 with embossed texture rolled into exposed surface.

1. Product: Subject to compliance with requirements, provide " <Insert product name> " by <Insert manufacturer's name>.

F. Stainless Steel Bars: ASTM A276, Type 304.

G. Stainless Steel Tubing: ASTM A554, Grade MT 304.

H. Rolled Steel Floor Plate: ASTM A786/A786M.

I. Rolled Stainless Steel Floor Plate: ASTM A793.

J. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Pattern 1, Alloy 6061-T6.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Examine hoistways, hoistway openings, pits, and machine rooms as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 INSTALLATION

A. Comply with manufacturer's written instructions.

B. Welded Construction: Provide welded connections for installing elevator work where

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bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.

C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.

D. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.

E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

B. Operating Test: Load [elevator][each elevator][one elevator of each type, capacity, speed, and travel distance] to rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding immediately to the next. Record temperature rise of elevator machine during 30-minute test period. Record failure to perform as required.

C. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 PROTECTION

A. Temporary Use: [Limit temporary use for construction purposes to one elevator.] Comply with the following requirements for [each] elevator used for construction purposes:

1. Provide protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
2. Do not load elevators beyond their rated weight capacity.
3. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide the same parts and supplies as those used in the manufacture and installation of original equipment.
4. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as

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required.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate [, adjust, and maintain] elevator(s).

B. Check operation of [each] elevator with Owner's personnel present and before date of Substantial Completion [and not more than one month before end of warranty period]. Determine that operation systems and devices are functioning properly.

3.6 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include <Insert number> months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Perform maintenance during normal working hours.
2. Perform emergency callback service during normal working hours with response time of [two]<Insert number> hours or less.
3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of [two]<Insert number> hours or less.

B. <Insert elevator maintenance agreement>.

END OF SECTION 142113

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SECTION 142123.16 - MACHINE ROOM-LESS ELECTRIC TRACTION PASSENGER ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Requirements:

1. Section 011000 "Summary" for purchase contract for elevators negotiated by Owner and assigned to Contractor.
2. Section 015000 "Temporary Facilities and Controls" for temporary use of elevators for construction purposes.
3. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
4. Section 042000 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
5. Section 051200 "Structural Steel Framing" for the following:

    a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
    b. Divider beams.
    c. Hoist beams.
    d. Structural-steel shapes for subsills.

6. Section 055000 "Metal Fabrications" for the following:

    a. Attachment plates and angle brackets for supporting guide-rail brackets.
    b. Divider beams.
    c. Hoist beams.
    d. Structural-steel shapes for subsills.
    e. Pit ladders.
    f. Cants made from steel sheet in hoistways.

7. Section 055213 "Pipe and Tube Railings" for railings between adjacent elevator pits.
8. Section 057000 "Decorative Metal" for combination hall push-button stations.
9. Section <Insert Section number> " <Insert Section title> " for finish flooring in elevator cars.
10. Section 099123 "Interior Painting" for field painting of hoistway entrance doors and frames.
11. Section 102213 "Wire Mesh Partitions" for guards between adjacent elevator pits.
12. Section 142113 "Electric Traction Freight Elevators" for electric traction elevators used primarily for carrying freight and inaccessible to the general public.
13. Section 221429 "Sump Pumps" for sump pumps, sumps, and sump covers in elevator pits.

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14. Section 271513 "Communications Copper Horizontal Cabling" for twisted pair cable for telephone service for elevators [and for connection to elevator controllers for remote monitoring of elevator performance].
15. [Section 284600 "Fire Detection and Alarm"][and][Section 284614 "Single- and Multiple-Station Alarms"] for smoke detectors in elevator lobbies to initiate emergency recall operation [, for heat detectors in shafts and machine rooms to disconnect power from elevator equipment before or on sprinkler activation,] and for connection to elevator controllers.

1.2 ALLOWANCES

A. Elevator Car Allowances: Provide finished passenger [and service] elevator cars under the Elevator Car Allowance specified in Section 012100 "Allowances." Allowance includes the following:

1. Car wall finishes including trim.
2. Car floor finishes.
3. Car ceiling finishes.
4. Car door finishes.
5. Hoistway door [and frame] finishes.
6. Car light fixtures.
7. Handrails.
8. Cutouts and other provisions for installing elevator signal equipment in cars.

1.3 DEFINITIONS

A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

B. Service Elevator: A passenger elevator that is also used to carry freight.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include capacities, sizes, performances, operations, safety features, finishes, and similar information.
2. Include Product Data for car enclosures, hoistway entrances, and operation, control, and signal systems.

B. Shop Drawings:

1. Include plans, elevations, sections, and large-scale details indicating service at each landing, coordination with building structure, relationships with other construction, and locations of equipment.
2. Include large-scale layout of car-control station [and standby power operation control panel].
3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

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C. Samples for Initial Selection: For each type of exposed finish involving color selection.

D. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; 3-inch- square Samples of sheet materials; and 4-inch lengths of running trim members.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway and pit layout and dimensions, as indicated on Drawings, and electrical service [including standby power generator], as shown and specified, are adequate for elevator system being provided.

D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

1. Submit manufacturer's or Installer's standard operation and maintenance manual, in accordance with ASME A17.1/CSA B44 [including diagnostic and repair information available to manufacturer's and Installer's maintenance personnel].

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

C. Continuing Maintenance Proposal:

1. Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard [one-year][two-year][five-year]<Insert agreement period> maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.
2. Submit a continuing maintenance proposal from Installer to Owner with terms, conditions, and obligations as set forth in, and in same form as, a "Draft of

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Elevator Maintenance Agreement" at end of this Section, starting on date initial maintenance service is concluded.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer [or an authorized representative who is trained and approved by manufacturer].

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.9 COORDINATION

A. Coordinate installation of inserts, sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, inserts, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

B. Coordinate locations and dimensions of work specified in other Sections that relates to electric traction elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways and pits.

1.10 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
2. Warranty Period: <Insert number> year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

B. Accessibility Requirements: Comply with requirements for accessible elevators in the

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United States Access Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.

2.2 ELEVATORS

A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.

B. Elevator Description:

1. Elevator Number(s): E-1 as indicated on Drawings.
2. Rated Load: 2100 lb.
3. Freight Loading Class for Service Elevator(s): Class A.
4. Rated Speed: 100 fpm 150 fpm.
5. Operation System: Selective-collective automatic operation.
6. Auxiliary Operations:

    a. Standby power operation.
    b. Standby-powered lowering.
    c. Battery-powered automatic evacuation.
    d. Earthquake Emergency Operation: Comply with requirements in ASME A17.1/CSA B44.
    e. Automatic dispatching of loaded car.
    f. Nuisance-call cancel.
    g. Loaded-car bypass.
    h. Distributed parking.
    i. [Emergency hospital][Priority] service at [all]<Insert floor designations> floors.
    j. Independent service for one car in group.

7. Security Features: [Card-reader operation][Keyswitch operation][Keypad operation][Car-to-lobby feature].
8. Dual Car-Control Stations: Provide two car-control stations [in each elevator]; equip only one with required keyswitches if any.
9. Car Enclosures:

    a. Inside Width: Not less than 68 inches from side wall to side wall.
    b. Inside Depth: Not less than 53 inches from back wall to front wall (return panels).
    c. Inside Height: Not less than [93 inches]<Insert dimension> to underside of ceiling.
    d. Front Walls (Return Panels): Satin stainless steel, ASTM A480/A480M, No. 4 finish.
    e. Car Fixtures: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
    f. Side and Rear Wall Panels: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
    g. Reveals: Black.
    h. Door Faces (Interior): Satin stainless steel, ASTM A480/A480M, No. 4 finish.

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i. Door Sills: Aluminum.
j. Ceiling: Luminous ceiling.
k. Handrails: 1-1/2 inches round satin stainless steel, at [sides][and][rear] of car.
l. Floor: Manufacturer's standard carpet.
m. Floor prepared to receive carpet (specified in Section 096816 "Sheet Carpeting").
n. Floor prepared to receive resilient flooring (specified in Section 096516 "Resilient Sheet Flooring").
o. Floor recessed and prepared to receive dimension stone tile (specified in Section 093033 "Stone Tiling").
p. Floor Thickness, Including Setting Materials: <Insert thickness> above plywood subfloor.

10. Hoistway Entrances:

a. Width: 54 inches.
b. Height: 84 inches.
c. Type: Two-speed side sliding.
d. Frames: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
e. Frames at Other Floors: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
f. Doors and Transoms: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
g. Doors and Transoms at Other Floors: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
h. Sills: Aluminum.
i. Sills at Other Floors: Aluminum.

11. Hall Fixtures: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
12. Hall Fixtures at Other Floors: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
13. Additional Requirements:

a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, ASTM A480/A480M, No. 4 finish.
b. Provide hooks for protective pads in [service car][all cars] and one complete set(s) of full-height protective pads.

2.3 TRACTION SYSTEMS

A. Elevator Machines: Permanent magnet, variable-voltage, variable-frequency, ac-type hoisting machines and solid-state power converters.

1. Provide [regenerative][or][nonregenerative] system.
2. Provide regenerative system that complies with the IgCC.
3. Limit total harmonic distortion of regenerated power to 5 percent in accordance with IEEE 519.
4. Provide means for absorbing regenerated power when elevator system is

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operating on standby power.

5. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system.

B. Fluid for Hydraulic Buffers: Fire-resistant fluid.

C. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.

D. Machine Beams: Provide steel framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Section 055000 "Metal Fabrications" for materials and fabrication.

E. Car Frame and Platform: Bolted- or welded-steel units.

2.4 OPERATION SYSTEMS

A. Provide manufacturer's standard microprocessor operation systems as required to provide type of operation indicated.

B. Auxiliary Operations:

1. Single-Car Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at [main lobby][fire-command station]<Insert location>. Manual operation causes automatic operation to cease.
2. Single-Car Standby-Powered Lowering: On activation of standby power, if car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to the next floor below, opens its doors, and shuts down.
3. Single-Car Battery-Powered Automatic Evacuation: If power fails and car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it moves to the next floor above or below, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
4. Group Standby Power Operation:

    a. On activation of standby power, cars are returned to a designated floor and parked with doors open. One car is returned at a time, with priority given to loaded cars. If a car cannot be returned after two attempts, it is removed from the system. When all cars have been returned or removed from the system, one car is automatically placed in service. If car selected for service cannot operate within 60 seconds, the system removes car from service and places another car in service. Cars can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at [main lobby][fire-command station]<Insert location>. Manual operation causes automatic operation to cease.
    b. On activation of standby power, cars are returned, one at a time, to a

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designated floor and parked with doors open. If a car cannot be returned, it is removed from the system. When all cars have been returned or removed from the system, one car can be put in service on standby power by a selector switch in control panel located at [main lobby][fire-command station]<Insert location>.

5. Group Battery-Powered Automatic Evacuation: If power fails, cars that are at a floor remain at that floor, open their doors, and shut down. Cars that are between floors are moved one at a time to the next floor above or below, open their doors, and shut down. System includes rechargeable battery and automatic recharging system.
6. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors begin closing.
7. Nuisance-Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls [and predetermined weight] can be adjusted.
8. Loaded-Car Bypass: When car load exceeds 80 percent of rated capacity, car responds only to car calls, not to hall calls.
9. Distributed Parking: When cars are not required for response to calls, they are parked with doors closed and distributed in predetermined zones throughout the building. One zone to include the main floor and adjacent floors; remaining floors to be divided into approximately equal zones.
10. Off-Peak Operation: During periods of low traffic, half of the elevators in a group to be taken out of service and switched to sleep, low power mode.
11. Independent Service: Keyswitch in car-control station removes car from group operation and allows it to respond only to car calls. Key cannot be removed from keyswitch when car is in independent service. When in independent service, doors close only in response to door close button.
12. Priority Service: Service is initiated by a [keyswitch][card reader][remote switch] at designated floors. One elevator is removed from group operation and directed to the floor where service was initiated. On arriving at the floor, elevator opens its doors and parks [and a lighted sign directs passengers to exit elevator]. Car is placed in operation by selecting a floor and pressing door close button or by operating keyswitch to put car in independent service. After responding to floor selected or being removed from independent service, car is returned to group operation. If car is not placed in operation within a preset time after being called, it is returned to group operation.

C. Security features may not affect emergency firefighters' service.

1. Card-Reader Operation: System uses card readers at [car-control stations][and][hall push-button stations] to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. [Allow space for card reader in car][Provide stripe-swipe card reader integral with each car-control station].

    a. Security access system equipment is [specified in Section 281500 "Access Control Hardware Devices."][not in the Contract.]

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2. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at [car-control stations][and][hall push-button stations]. Key is removable [only in deactivated][in either] position.
3. Keypad Operation: Allows each landing to be restricted or unrestricted. When a restricted landing button is pressed, a "Restricted Floor" lamp lights and remains lit until landing access code has been entered into a keypad or predetermined time has elapsed. Car calls for restricted landings do not register until landing access code is entered into keypad within predetermined time after landing button is pressed.

    a. Access codes are programmed at each car operating panel using a security keyswitch. Keypad operation can be activated and deactivated by security keyswitch at main landing.

4. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes [car][all cars in a group] to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

2.5 DOOR REOPENING DEVICES

A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams causes doors to stop and reopen.

B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer sounds and doors begins to close at reduced kinetic energy.

2.6 CAR ENCLOSURES

A. Provide [enameled or powder-coated steel car enclosures to receive removable][steel-framed car enclosures with nonremovable] wall panels, with [removable] car roof, access doors, power door operators, and ventilation.

1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.
2. See "Elevator Car Allowances" Paragraph in "Allowances" Article for items to be provided under the Elevator Car Allowance. Provide items not included in the Elevator Car Allowance as needed for finished car including materials and finishes specified below.

B. Materials and Finishes: Manufacturer's standards, but not less than the following:

1. Subfloor:

    a. Exterior, underlayment grade plywood, not less than 5/8-inch nominal thickness.
    b. Exterior, C-C Plugged grade plywood, not less than 7/8-inch nominal

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thickness.

2. Floor Finish:

    a. Specified in Section <Insert Section number> " <Insert Section title> ".
    b. Elevator manufacturer's standard level-loop nylon carpet; color as selected by Architect from full range of industry colors.

3. Enameled or Powder-Coated Steel Wall Panels: Flush, formed-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel or powder-coat finish; colors as selected by Architect from manufacturer's full range.
4. Stainless Steel Wall Panels: Flush, formed-metal construction; fabricated from stainless steel sheet.
5. Bronze Wall Panels: Flush, formed-metal construction; fabricated from bronze sheet.
6. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to [1/2-inch fire-retardant-treated particleboard][manufacturer's standard honeycomb core][manufacturer's standard formed metal panels] with [plastic-laminate panel backing and] manufacturer's standard protective edge trim. Panels to have a flame-spread index of [25][75] or less, when tested in accordance with ASTM E84. Plastic-laminate color, texture, and pattern as selected by Architect from [plastic-laminate][elevator] manufacturer's full range.
7. Fabricate car with recesses and cutouts for signal equipment.
8. Fabricate car door frame integrally with front wall of car.
9. Enameled or Powder-Coated Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel or powder-coat finish; colors as selected by Architect from manufacturer's full range.
10. Primed or Powder-Coated Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet, with factory-applied, rust-resistant primer or powder-coating for field painting.
11. Stainless Steel Doors: Flush, hollow-metal construction; fabricated [from stainless steel sheet][or][by laminating stainless steel sheet to exposed faces and edges of enameled or powder-coated steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning].
12. Bronze Doors: Flush, hollow-metal construction; fabricated by laminating bronze sheet to exposed faces and edges of enameled or powder-coated steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
13. Plastic-Laminate Doors: Flush, hollow-metal construction; fabricated by laminating plastic laminate to exposed faces of enameled or powder-coated steel doors and covering edges with protective edge trim [matching return panels]. Plastic-laminate color, texture, and pattern as selected by Architect from [plastic-laminate][elevator] manufacturer's full range.
14. Unfinished-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet, with factory-applied enamel or powder-coating.
15. Sight Guards: Provide sight guards on car doors.
16. Sills: Extruded or machined metal, with grooved surface, 1/4 inch thick.
17. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.

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18. Ceiling: [Metal][Metallic-finish, plastic-laminate] flush panels, with [incandescent downlights in the center of][four low-voltage downlights in] each panel. [Align ceiling panel joints with joints between wall panels.]

2.7 HOISTWAY ENTRANCES

A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile to accommodate hoistway wall construction.

1. Where gypsum board wall construction is indicated, frames to be self-supporting with reinforced head sections.

B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies to comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible in accordance with [NFPA 252][or][UL 10B].

1. Fire-Protection Rating: [1 hour][1-1/2 hours]<Insert rating>[with 30-minute temperature rise of 450 deg F].

C. Materials and Fabrication: Manufacturer's standards, but not less than the following:

1. Enameled or Powder-Coated Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied enamel or powder-coat finish; colors as selected by Architect from manufacturer's full range.
2. Primed or Powder-Coated Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied, rust-resistant primer or powder-coating for field painting.
3. Steel Subframes: Formed from cold- or hot-rolled steel sheet, with factory-applied enamel or powder-coat finish or rust-resistant primer. Fabricate to receive applied finish as indicated.
4. Stainless Steel Frames: Formed from stainless steel sheet.
5. Bronze Frames: Formed from cold- or hot-rolled steel sheet, with enamel or powder-coat finish, and with formed-bronze sheet laminated to steel frames using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
6. Star of Life Symbol: Identify emergency elevators with star of life symbol, not less than 3 inches high, on both jambs of hoistway door frames.
7. Enameled or Powder-Coated Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel or powder-coat finish; colors as selected by Architect from manufacturer's full range.
8. Primed or Powder-Coated Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied, rust-resistant primer or powder-coating for field painting.
9. Stainless Steel Doors and Transoms: Flush, hollow-metal construction; fabricated [from stainless steel sheet][or][by laminating stainless steel sheet to exposed faces and edges of enameled or powder-coated steel doors using

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adhesive that fully bonds metal to metal without telegraphing or oil-canning].

10. Bronze Doors and Transoms: Flush, hollow-metal construction; fabricated by laminating bronze sheet to exposed faces and edges of enameled or powder-coated steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
11. Plastic-Laminate Doors and Transoms: Flush, hollow-metal construction; fabricated by laminating plastic laminate to exposed faces of enameled or powder-coated steel doors and covering edges with protective edge trim [matching door frames]. Plastic-laminate color, texture, and pattern as selected by Architect from [plastic-laminate][elevator] manufacturer's full range.
12. Unfinished-Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet, with factory-applied enamel or powder-coating.
13. Sight Guards: Provide sight guards on doors matching door edges.
14. Sills: Extruded or machined metal, with grooved surface, 1/4 inch thick.
15. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M.

2.8 SIGNAL EQUIPMENT

A. Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Provide [vandal-resistant] buttons and lighted elements illuminated with LEDs.

B. Car-Control Stations: Provide manufacturer's standard [recessed][or][semirecessed] car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.

1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

C. Swing-Return Car-Control Stations: Provide car-control stations mounted on rear of hinged return panel adjacent to car door and with buttons, switches, controls, and indicator lights projecting through return panel but substantially flush with face of return panel.

1. Mark buttons and switches for function. Use both tactile symbols and Braille.
2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

D. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

E. Firefighters' Two-Way Telephone Communication Service: Provide [flush-mounted

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cabinet][telephone jack] in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in [Section 284600 "Fire Detection and Alarm."][Section 284614 "Single- and Multiple-Station Alarms."][Section 284600 "Fire Detection and Alarm" and Section 284614 "Single- and Multiple-Station Alarms."]

F. Car Position Indicator: Provide [illuminated,] digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.

G. Hall Push-Button Stations: [Provide one hall push-button station at each landing][Provide one hall push-button station at each landing for each single elevator or group of elevators, but not less than one station for each four elevators in a group][Provide hall push-button stations at each landing as indicated].

1. Provide [manufacturer's standard wall-mounted units][units with flat faceplate for mounting with body of unit recessed in wall].
2. Equip units with buttons for calling elevator and for indicating desired direction of travel.

    a. Provide for connecting units to building security access system so a card reader can be used to register calls.

3. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in [Section 284600 "Fire Detection and Alarm."][Section 284614 "Single- and Multiple-Station Alarms."][Section 284600 "Fire Detection and Alarm" and Section 284614 "Single- and Multiple-Station Alarms."]

H. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide [one of] the following:

1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
2. Units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.
3. Units mounted in both jambs of entrance frame [for each elevator].
4. Units mounted in both car door jambs [; may be used only for single elevators or for two-car groups].

I. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.

1. At manufacturer's option, audible signals may be placed on cars.

J. Hall Position Indicators: Provide [illuminated,] digital-display-type position indicators, located above [each] hoistway entrance at ground floor. Provide units with flat faceplate and with body of unit recessed in wall.

1. Integrate ground-floor hall lanterns with hall position indicators.

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K. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1/CSA B44, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed. [For each elevator, provide illuminated signals that indicate when they are operational and when they are at the designated emergency return level with doors open.]

L. Fire-Command-Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.

M. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

N. <Insert requirements>.

2.9 FINISH MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, commercial steel, Type B, exposed, matte finish.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, commercial steel, Type B, pickled.

C. Stainless Steel Sheet: ASTM A240/A240M, Type 304.

D. Textured Stainless Steel Sheet: ASTM A240/A240M, Type 304 with embossed texture rolled into exposed surface.

1. Product: Subject to compliance with requirements, provide " <Insert product name or designation> " by <Insert manufacturer's name>.
2. Metal surface is [satin polished][satin relieved][titanium nitride colored][oxide colored][satin polished and titanium nitride colored][satin relieved and titanium nitride colored][satin polished and oxide colored][satin relieved and oxide colored][color coated and satin relieved][color coated and bright relieved] after texturing.

E. Stainless Steel Bars: ASTM A276/A276M, Type 304.

F. Stainless Steel Tubing: ASTM A554, Grade MT 304.

G. Bronze Plate and Sheet: ASTM B36/B36M, Alloy UNS No. C28000 (muntz metal).

H. Bronze Extrusions: ASTM B455/B455M, Alloy UNS No. C38500 (architectural bronze).

I. Bronze Tubing: ASTM B135/B135M, Alloy UNS No. C23000 (red brass, 85 percent

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copper).

J. Aluminum Extrusions: ASTM B221, Alloy 6063.

K. Nickel Silver Extrusions: ASTM B151/B151M, Alloy UNS No. C74500 or UNS No. C77600.

L. Plastic Laminate: High-pressure type complying with ISO 4586-3, [Type HGS for flat applications][Type HGL for flat applications][Type HGP for postformed applications][and][Type BKV for panel backing].

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Examine hoistways, hoistway openings, and pits as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

B. Operating Test: Load [elevator][each elevator][one elevator of each type, capacity, speed, and travel distance] to rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding immediately to the next. Record temperature rise of elevator machine during 30-minute test period. Record failure to perform as required.

C. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.3 PROTECTION

A. Temporary Use: [Limit temporary use for construction purposes to one elevator.] Comply with the following requirements for [each] elevator used for construction purposes:

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1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
2. Provide strippable protective film on entrance and car doors and frames.
3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
5. Do not load elevators beyond their rated weight capacity.
6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate [, adjust, and maintain] elevator(s).

B. Check operation of [each] elevator with Owner's personnel present before date of Substantial Completion [and again not more than one month before end of warranty period]. Determine that operation systems and devices are functioning properly.

3.5 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service to include <Insert number> months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Parts and supplies to be manufacturer's authorized replacement parts and supplies.

1. Perform maintenance during normal working hours.
2. Perform emergency callback service during normal working hours with response time of [two]<Insert number> hours or less.
3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of [two]<Insert number> hours or less.

B. <Insert elevator maintenance agreement>.

END OF SECTION 142123.16

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SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. 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 waterstop 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. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

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

1. Smith, Jay R. Mfg. Co.
2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

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

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. 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: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. 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. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."

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: Galvanized-steel-pipe sleeves.
    b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.

2. Exterior Concrete Walls below Grade:

    a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

    b. Piping NPS 6 Cast-iron wall sleeves with sleeve-seal system.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

    a. Piping Smaller Than NPS 6. Cast-iron wall sleeves with sleeve-seal system.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

    b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.

5. Interior Partitions:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 210517

SECTION 210518 - ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.3 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

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 polished, chrome-plated finish.
i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.

j. Bare Piping in Equipment Rooms: One-piece, cast-brass polished, chrome-plated finish.
k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.

2. Escutcheons for Existing Piping:

a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.

c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.

e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.

g. Bare Piping in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated finish.
h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge.

i. Bare Piping in Equipment Rooms: Split-casting brass type with polished, chrome-plated finish.
j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed hinge.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.
2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

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

END OF SECTION 210518

SECTION 210548 - VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Restraining braces.

1.2 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.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: 2009.

2. Assigned Seismic Use Group or Building Category as Defined in the IBC: 2021.

a. Component Importance Factor: as required by IBC 2021.
b. Component Response Modification Factor: as required by IBC 2021.
c. Component Amplification Factor: as required by IBC 2021.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): as required by IBC 2021.
4. Design Spectral Response Acceleration at 1-Second Period: as required by IBC 2021.

1.4 SUBMITTALS

A. Product Data: For each product indicated.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation and licensed in the State of New Jersey.

C. Welding certificates.

D. Qualification Data: For professional engineer.

1.5 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC and NFPA 13 unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

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

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Mason Industries.
7. Vibration Eliminator Co., Inc.

8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Restrained Mounts: All-directional mountings with seismic restraint.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

2.2 SEISMIC-RESTRAINT DEVICES

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

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti, Inc.
5. Kinetics Noise Control.
6. Loos & Co.; Cableware Division.
7. Mason Industries.
8. TOLCO Incorporated; a brand of NIBCO INC.
9. Unistrut; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

E. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

G. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

PART 3 - EXECUTION

3.1 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127 and NFPA 13.

2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

C. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

D. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

F. Drilled-in Anchors:

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. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.2 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 21 Section "Wet Pipe Sprinkler System" for piping flexible connections.

END OF SECTION 210548

SECTION 211313 - 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 SUMMARY

A. Section Includes:
   1. Wet Pipe Sprinkler Systems
   2. Automatic wet-type standpipe systems
   3. Dry-pipe sprinkler systems.
   4. Fire-protection valves.
   5. Fire-department connections.
   6. Sprinklers.
   7. Alarm devices.
   8. Manual control stations.
   9. Control panels.
   10. Pressure gages.

B. Related Sections:

   1. Division 21 Section "Sleeve and Sleeve Seals for Fire Suppression Piping" for sleeves and seals.

   2. Division 21 Section "Escutcheons for Fire Suppression Piping" for escutcheons.

   3. Division 21 Section "Vibration and Seismic Controls for Fire Suppression Piping" for seismic restraint requirements.

1.3 DEFINITIONS

A. High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psig, but not higher than 300 psig.

B. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.4 SYSTEM DESCRIPTIONS

A. Combined Standpipe and Sprinkler System: Fire-suppression system with both standpipe and sprinkler systems. Sprinkler system is supplied from standpipe system.

B. Automatic Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.

C. Automatic Wet-Type, Class II Standpipe System: Includes NPS 1-1/2 hose stations. Has open water-supply valve with pressure maintained and is capable of supplying water demand.

D. Automatic Wet-Type, Class III Standpipe System: Includes NPS 1-1/2 hose stations and NPS 2-1/2 hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.

E. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from opened sprinklers.

F. 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.

1.5 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. High-Pressure Piping System Component: Listed for 300-psig working pressure.

C. Fire-suppression standpipe system design shall be approved by authorities having jurisdiction.

1. Minimum residual pressure at each hose-connection outlet is the following:

    a. NPS 1-1/2 Hose Connections: 65 psig
    b. NPS 2-1/2 Hose Connections: 100 psig.

2. Unless otherwise indicated, the following is maximum residual pressure at required flow at each hose-connection outlet:

    a. NPS 1-1/2 Hose Connections: 100 psig
    b. NPS 2-1/2 Hose Connections: 175 psig

D. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.

E. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated. Sprinkler system shall be designed using hydraulic calculations in accordance with NFPA 13 requirements.

F. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications – See drawings for Occupancy Hazard Classifications.
3. Maximum Protection Area per Sprinkler: Per UL listing.
4. Maximum Protection Area per Sprinkler: See drawings
5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:

    a. Light-Hazard Occupancies: 100 gpm for 30 minutes
    b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes
    c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes

G. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13. See specification section 210548.

1.6 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. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. 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. Compressed air piping.
3. HVAC ducts & equipment.

4. Items penetrating finished ceiling include the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.

E. Qualification Data: For qualified Installer and Designer.

F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable. Drawings and Hydraulic Calculations shall be signed and sealed by a professional engineer licensed in the state of New Jersey.

G. Welding certificates.

H. Fire-hydrant flow test report.

I. 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."

J. Field quality-control reports.

K. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

    a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. 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.

D. 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 14, "Installation of Standpipe, Private Hydrant, and Hose Systems."
4. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.8 PROJECT CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify Architect/Engineer and Construction Manager no fewer than two days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Architect's and Construction Manager's written permission.

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 six spare sprinklers plus sprinkler wrench for each type of sprinkler used in the project. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Coordinate final location of cabinet with Architect.

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.

2.2 STEEL PIPE AND FITTINGS

A. Standard Weight, Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

C. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.

D. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME 16.1, Class 125.

G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

H. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

I. Grooved-Joint, Steel-Pipe Appurtenances:

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

2. Pressure Rating: 300 psig minimum.
3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.

4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

J. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

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

   a. Victaulic Company.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

D. Plastic, Pipe-Flange Gasket, and Bolts and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.4 COVER SYSTEM FOR SPRINKLER PIPING

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. DecoShield Systems, Inc.

B. Description: System of support brackets and covers made to protect sprinkler piping.

C. Brackets: Glass-reinforced nylon.

D. Covers: Extruded PVC sections of length, shape, and size required for size and routing of CPVC piping.

2.5 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
3. Minimum Pressure Rating for High-Pressure Piping: 300 psig.

B. Ball Valves:

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. Anvil International, Inc.
b. Victaulic Company.

2. Standard: UL 1091 except with ball instead of disc.
3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
5. Valves NPS 3: Ductile-iron body with grooved ends.

C. Bronze Butterfly Valves:

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. Fivalco Inc.
b. Global Safety Products, Inc.
c. Milwaukee Valve Company.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

D. Iron Butterfly Valves:

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. Anvil International, Inc.
b. Global Safety Products, Inc.
c. Kennedy Valve; a division of McWane, Inc.
d. NIBCO INC.
e. Tyco Fire & Building Products LP.
f. Victaulic Company.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Cast or ductile iron.

5. Style: Lug or wafer.
6. End Connections: Grooved.

E. Check Valves:

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

    a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
    b. Anvil International, Inc.
    c. Clow Valve Company; a division of McWane, Inc.
    d. Crane Co.; Crane Valve Group; Crane Valves.
    e. Crane Co.; Crane Valve Group; Jenkins Valves.
    f. Crane Co.; Crane Valve Group; Stockham Division.
    g. NIBCO INC.
    h. Potter Roemer.
    i. Reliable Automatic Sprinkler Co., Inc.
    j. Tyco Fire & Building Products LP.
    k. Victaulic Company.
    l. Viking Corporation.
    m. Watts Water Technologies, Inc.

2. Standard: UL 312.
3. Pressure Rating: 300 psig.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

F. Bronze OS&Y Gate Valves:

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. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Stockham Division.
    c. Milwaukee Valve Company.
    d. NIBCO INC.
    e. United Brass Works, Inc.

2. Standard: UL 262.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

G. Iron OS&Y Gate Valves:

1. 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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division..
d. NIBCO INC.
e. Tyco Fire & Building Products LP.
f. United Brass Works, Inc.
g. Watts Water Technologies, Inc.

2. Standard: UL 262.
3. Pressure Rating: 300 psig.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

H. Indicating-Type Butterfly Valves:

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. Anvil International, Inc.
b. Kennedy Valve; a division of McWane, Inc.
c. NIBCO INC.
d. Tyco Fire & Building Products LP.
e. Victaulic Company.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2 and Smaller:

a. Valve Type: Ball or butterfly.
b. Body Material: Bronze.
c. End Connections: Threaded.

5. Valves NPS 2-1/2 and Larger:

a. Valve Type: Butterfly.
b. Body Material: Cast or ductile iron.
c. End Connections: Flanged, grooved, or wafer.

6. Valve Operation: Integral, 115-V ac, prewired, two-circuit, supervisory switch visual indicating device.

I. NRS Gate Valves:

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. Crane Co.; Crane Valve Group; Stockham Division.
b. Kennedy Valve; a division of McWane, Inc.
c. NIBCO INC.
d. Tyco Fire & Building Products LP.

2. Standard: UL 262.
3. Pressure Rating: 300 psig.
4. Body Material: Cast iron with indicator post flange.
5. Stem: Nonrising.
6. End Connections: Flanged or grooved.

2.6 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

B. Angle Valves:

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. Fire Protection Products, Inc.
b. United Brass Works, Inc.

C. Ball Valves:

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. Anvil International, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Kennedy Valve; a division of McWane, Inc.
d. NIBCO INC.
e. Potter Roemer.
f. Tyco Fire & Building Products LP.
g. Victaulic Company.
h. Watts Water Technologies, Inc.

D. Globe Valves:

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. Fire Protection Products, Inc.
b. United Brass Works, Inc.

E. Plug Valves:

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. Southern Manufacturing Group.

2.7 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:

a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
b. High-Pressure Piping Specialty Valves: 300 psig.

3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

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

a. Reliable Automatic Sprinkler Co., Inc.
b. Tyco Fire & Building Products LP.
c. Victaulic Company.
d. Viking Corporation.

2. Standard: UL 193.
3. Design: For horizontal or vertical installation.

4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.

5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Automatic (Ball Drip) Drain Valves:

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. AFAC Inc.
    b. Reliable Automatic Sprinkler Co., Inc.
    c. Tyco Fire & Building Products LP.

2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

D. Dry-Pipe Valves: UL 260, differential type; with bronze seat with O-ring seals, single-hinge pin, and latch design. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

    a. Air-Pressure Maintenance Device: UL 260, automatic device to maintain correct air pressure in piping. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig maximum inlet pressure.

        1) Available Manufacturers:

            a) AFAC Inc.
            b) Central Sprinkler Corp.
            c) General Air Products, Inc.
            d) Globe Fire Sprinkler Corporation.
            e) Grinnell Fire Protection.
            f) Reliable Automatic Sprinkler Co., Inc.
            g) Star Sprinkler Inc.
            h) Viking Corp.

    b. Air Compressor: UL 753, fractional horsepower, 120-V ac, 60 Hz, single phase.

        1) Available Manufacturers:

            a) AFAC Inc.
            b) Gast Manufacturing, Inc.
            c) Grinnell Fire Protection.
            d) Reliable Automatic Sprinkler Co., Inc.
            e) Viking Corp.

2.8 FIRE-DEPARTMENT CONNECTIONS

A. Exposed-Type, Fire-Department Connection:

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. AFAC Inc.
    b. Elkhart Brass Mfg. Company, Inc.
    c. GMR International Equipment Corporation.
    d. Guardian Fire Equipment, Inc.
    e. Tyco Fire & Building Products LP.

2. Standard: UL 405.
3. Type: Exposed, projecting, for wall mounting.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, wall type.
9. Outlet: Back, with pipe threads.
10. Number of Inlets: Two.

11. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE”
12. Finish: Polished chrome plated.
13. Coordinate requirements for fire department connection with local Fire Department requirements.

B. Flush-Type, Fire-Department Connection:

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. AFAC Inc.
    b. Elkhart Brass Mfg. Company, Inc.
    c. GMR International Equipment Corporation.
    d. Guardian Fire Equipment, Inc.
    e. Potter Roemer.

2. Standard: UL 405.
3. Type: Flush, for wall mounting.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.

6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Rectangular, brass, wall type.
9. Outlet: With pipe threads.

10. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
11. Finish: Polished chrome plated
12. Coordinate requirements for fire department connection with local Fire Department requirements.

2.9 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

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. Anvil International, Inc.
   b. National Fittings, Inc.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.

2. Standard: UL 213.
3. Pressure Rating: 300 psig.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

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. AGF Manufacturing Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 300 psig.

4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

C. Branch Line Testers:

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. Elkhart Brass Mfg. Company, Inc.
   b. Fire-End & Croker Corporation.
   c. Potter Roemer.

2. Standard: UL 199.
3. Pressure Rating: 175 psig.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

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. Tyco Fire & Building Products LP.
   b. Victaulic Company.
   c. Viking Corporation.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 300 psig.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. 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. CECA, LLC.
   b. Corcoran Piping System Co.
   c. Merit Manufacturing; a division of Anvil International, Inc.

2. Standard: UL 1474.
3. Pressure Rating: [250 psig minimum] [300 psig].
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

F. Flexible, Sprinkler Hose Fittings:

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. Fivalco Inc.
   b. FlexHead Industries, Inc.
   c. Gateway Tubing, Inc.

2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 300 psig.
5. Size: Same as connected piping, for sprinkler.

2.10 SPRINKLERS

A. 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. Globe Fire Sprinkler Corporation.
2. Reliable Automatic Sprinkler Co., Inc.
3. Tyco Fire & Building Products LP.
4. Victaulic Company.
5. Viking Corporation.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Residential Sprinklers: 175 psig maximum.
3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
4. Pressure Rating for High-Pressure Automatic Sprinklers: 300 psig.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Residential Applications: UL 1626.

4. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes: (Coordinate finish type with Architect)

1. Chrome plated.
2. Bronze.
3. Painted.

E. Special Coatings:

1. Corrosion-resistant paint.
2. Wax

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, one piece, flat
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards:

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. Reliable Automatic Sprinkler Co., Inc.
b. Tyco Fire & Building Products LP.
c. Victaulic Company.
d. Viking Corporation.

2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.11 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:

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. Globe Fire Sprinkler Corporation.
b. Tyco Fire & Building Products LP.
c. Victaulic Company.
d. Viking Corporation.

2. Standard: UL 753.
3. Type: Mechanically operated, with Pelton wheel.
4. Alarm Gong: Cast aluminum with red-enamel factory finish.
5. Size: 10-inch diameter.
6. Components: Shaft length, bearings, and sleeve to suit wall construction.
7. Inlet: NPS 3/4.
8. Outlet: NPS 1 drain connection.

C. Electrically Operated Alarm Bell:

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. Fire-Lite Alarms, Inc.; a Honeywell company.
b. Notifier; a Honeywell company.
c. Potter Electric Signal Company.

2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.
4. Finish: Red-enamel factory finish, suitable for outdoor use.

D. Water-Flow Indicators:

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. ADT Security Services, Inc.
b. McDonnell & Miller; ITT Industries.
c. Potter Electric Signal Company.
d. System Sensor; a Honeywell company.
e. Viking Corporation.
f. Watts Industries (Canada) Inc.

2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.

6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

E. Pressure Switches:

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. Potter Electric Signal Company.
   b. System Sensor; a Honeywell company.
   c. Tyco Fire & Building Products LP.
   d. United Electric Controls Co.
   e. Viking Corporation.

2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

F. Valve Supervisory Switches:

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. Fire-Lite Alarms, Inc.; a Honeywell company.
   b. Kennedy Valve; a division of McWane, Inc.
   c. Potter Electric Signal Company.
   d. System Sensor; a Honeywell company.

2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

G. Indicator-Post Supervisory Switches:

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. Potter Electric Signal Company.
   b. System Sensor; a Honeywell company.

2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.

5. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.12 MANUAL CONTROL STATIONS

A. Description: UL listed or FM approved, hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.13 PRESSURE GAGES

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. AMETEK; U.S. Gauge Division.
2. Ashcroft, Inc.
3. Brecco Corporation.
4. WIKA Instrument Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0 to 300 psig.

E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13, NFPA 14 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-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Coordinate with site drawings and specifications for requirements.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 WATER-SUPPLY CONNECTIONS

A. Install shutoff valve, backflow preventer, alarm valve, pressure gage, drain, and other accessories indicated at connection to water-distribution piping. Comply with requirements for backflow preventers in Division 22 Section "Domestic Water Piping Specialties."

B. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.4 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 Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Install seismic restraints on piping. 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 drain valves on standpipes.

K. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

L. Install alarm devices in piping systems.

M. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

N. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

O. Fill sprinkler system piping with water.

P. Drain dry-type standpipe piping.

Q. Connect compressed-air supply to dry-pipe sprinkler piping.

R. Connect air compressor to the following piping and wiring:

1. Pressure gages and controls.
2. Electrical power system.
3. Fire alarm devices, including low-pressure alarm.

S. Electrical Connections: Power wiring is specified in Division 26.

T. Connect alarm devices to fire alarm.

U. Drain dry-pipe sprinkler piping.

V. Pressurize and check dry-pipe sprinkler system piping and air-pressure maintenance devices.

W. Earthquake Protection: Install piping according to NFPA 13 to protect from earthquake damage.

X. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."

Y. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."

Z. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 21 Section "Escutcheons for Fire-Suppression Piping."

AA. Install flexible connectors on fire-pump and pressure-maintenance-pump supply and discharge connections and in fire-suppression piping where indicated.

3.5 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. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

L. 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.

M. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

N. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

O. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

P. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.

Q. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

R. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

S. Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3.6 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and with NFPA 13 or NFPA 13R for supports.

3.7 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. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.8 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.9 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire-department connections.

B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.10 HOSE-CONNECTION INSTALLATION

A. Install hose connections adjacent to standpipes, unless otherwise indicated.

B. Install freestanding hose connections for access and minimum passage restriction.

C. Install NPS 1-1/2 hose-connection valves with flow-restricting device, unless otherwise indicated.

D. Install NPS 2-1/2 hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 reducer adapter and flow-restricting device, unless otherwise indicated.

E. Install wall-mounting-type hose connections in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Refer to Division 10 Section "Fire Extinguisher Cabinets" for cabinets.

3.11 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.12 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.

3.13 CLEANING

A. Clean dirt and debris from sprinklers.

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

3.14 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.15 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe.

B. Sprinkler specialty fittings may be used, downstream of control vales, instead of specified fittings.

C. High-pressure, wet-pipe sprinkler system, NPS 4 and smaller, shall be one of the following:

1. Standard-weight galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.

D. High-pressure, wet-pipe sprinkler system, NPS 5 and larger shall be one of the following:

1. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.

E. High-pressure, dry-pipe sprinkler system, NPS 4 and smaller, shall be one of the following:

1. Standard-weight galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.

F. High-pressure, dry-pipe sprinkler system, NPS 5 and larger shall be one of the following:

1. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

2. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.

3.16 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers
3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Upright, pendent, sprinkler with heat tape; and sidewall sprinklers with heat tape as indicated.
5. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Upright, Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313

SECTION 220500 - COMMON WORK REQUIREMENTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. Plumbing demolition.
8. Equipment installation requirements common to equipment sections.
9. Concrete bases.
10. Supports and anchorages.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than plumbing 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 plumbing 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.

1.3 SUBMITTALS

A. Welding certificates.

1.4 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 Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, 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 or BAg1, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12.

G. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

2.3 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Stainless steel. Include two for each sealing element.

D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

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. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated

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 (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using 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.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) 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 (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. 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.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

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

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing 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.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi (20.7-MPa) 28-day compressive-strength concrete and reinforcement as specified in Division 03 Sections.

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 plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.9 GROUTING

A. Mix and install grout for plumbing 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.

END OF SECTION 220500

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. 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 waterstop 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. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

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

1. Smith, Jay R. Mfg. Co.
2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

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

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. 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: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. 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. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."

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. Galvanized-steel wall sleeves.
b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves

2. Exterior Concrete Walls below Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve seal.

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: Galvanized-steel wall sleeves with sleeve seal.

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 : Galvanized-steel wall sleeves with sleeve seal.

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: Galvanized-steel wall sleeves with sleeve seal.

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.
b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves.

5. Interior Partitions:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.3 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

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 insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
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 polished, chrome-plated 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 polished, chrome-plated finish.
k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.

2. Escutcheons for Existing Piping:

a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.

c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.

e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.

g. Bare Piping in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated finish.
h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge.

i. Bare Piping in Equipment Rooms: Split-casting brass type with polished, chrome-plated finish.
j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed hinge.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.
2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

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

END OF SECTION 220518

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bronze angle valves.
2. Brass ball valves.
3. Bronze ball valves.
4. Iron ball valves.
5. Iron, single-flange butterfly valves.
6. Iron, grooved-end butterfly valves.
7. Bronze lift check valves.
8. Bronze swing check valves.
9. Iron swing check valves.
10. Iron swing check valves with closure control.
11. Iron, grooved-end swing check valves.
12. Iron, center-guided check valves.
13. Iron, plate-type check valves.
14. Bronze gate valves.
15. Iron gate valves.
16. Bronze globe valves.
17. Iron globe valves.
18. Lubricated plug valves.
19. Chainwheels.

B. Related Sections:

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

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.

2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller.
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. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.

3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

A. One-Piece, Full-Port, Brass Ball Valves with Brass Trim:

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

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Div.
d. Grinnell Corporation.
e. Jamesbury, Inc.
f. NIBCO INC.
g. Watts Industries, Inc.; Water Products Div.
h. Kitz Corporation.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 400 psig.
c. Body Design: One piece.
d. Body Material: Forged brass.
e. Ends: Threaded.
f. Seats: PTFE or TFE.
g. Stem: Brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

B. Three-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

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

a. Jomar International, LTD.
b. Kitz Corporation.
c. Marwin Valve; a division of Richards Industries.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
e. Conbraco Industries, Inc.; Apollo Div.
f. Grinnell Corporation.
g. Jamesbury, Inc.
h. NIBCO INC.
i. PBM, Inc.

2. Controls Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.

d. Body Design: Three piece.
e. Body Material: Forged brass.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

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

a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. American Valve, Inc.
c. Conbraco Industries, Inc.; Apollo Valves.
d. Cooper Cameron Valves; a division of Cooper Cameron Corp.
e. Crane Co.; Crane Valve Group; Jenkins Valves.
f. Crane Co.; Crane Valve Group; Stockham Division.
g. DeZurik Water Controls.
h. Dover Corp.; Dover Resources Company; Norriseal Div.
i. Flo Fab Inc.
j. Grinnell Corporation
k. Hammond Valve.
l. Kitz Corporation.
m. Legend Valve.
n. Milwaukee Valve Company.
o. Mueller Steam Specialty; a division of SPX Corporation.
p. NIBCO INC.
q. Norriseal; a Dover Corporation company.
r. Red-White Valve Corporation.
s. Spence Strainers International; a division of CIRCOR International.
t. Sure Flow Equipment Inc.
u. Tyco International, Ltd.; Tyco Valves & Controls.
v. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.

e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

2.4 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 150, Single-Flange, High-Performance Butterfly Valves:

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

a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. Bray Controls; a division of Bray International.
c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
d. Crane Co.; Crane Valve Group; Flowseal.
e. Crane Co.; Crane Valve Group; Stockham Division.
f. DeZurik Water Controls.
g. Hammond Valve.
h. Jamesbury; a subsidiary of Metso Automation.
i. Milwaukee Valve Company.
j. NIBCO INC.
k. Process Development & Control, Inc.
l. Tyco Valves & Controls; a unit of Tyco Flow Control.
m. Xomox Corporation.

2. Description:

a. Standard: MSS SP-68.
b. CWP Rating: 285 psig at 100 deg F.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: Carbon steel, cast iron, ductile iron, or stainless steel.
e. Seat: Reinforced PTFE or metal.
f. Stem: Stainless steel; offset from seat plane.
g. Disc: Carbon steel.
h. Service: Bidirectional.

2.5 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

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

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.

c. Crane Co.; Crane Valve Group; Stockham Division.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.6 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:

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

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Grinnell Corporation.
f. Kitz Corporation.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Red-White Valve Corporation.
j. Watts Industries, Inc.; Water Products Div.
k. Zy-Tech Global Industries, Inc.

2. Description:

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

2.7 IRON SWING CHECK VALVES

A. Class 250, Iron Swing Check Valves with Metal Seats:

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

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Cincinnati Valve Company
e. Flomatic Valves
f. Grinnell Corporation
g. Hammond Valve.
h. Milwaukee Valve Company.
i. NIBCO INC.
j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-71, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
c. NPS 14 to NPS 24, CWP Rating: 300 psig.
d. Body Design: Clear or full waterway.
e. Body Material: ASTM A 126, gray iron with bolted bonnet.
f. Ends: Flanged.
g. Trim: Bronze.
h. Gasket: Asbestos free.

2.8 BRONZE GATE VALVES

A. Class 150, NRS Bronze Gate Valves:

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

a. Hammond Valve.
b. Kitz Corporation.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Powell Valves.
f. Red-White Valve Corporation.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
h. American Valve, Inc.
i. Grinnell Corporation.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.

e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron bronze, or aluminum.

2.9 IRON GATE VALVES

A. Class 250, NRS, Iron Gate Valves:

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

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. NIBCO INC.
d. Cincinnati Valve Company
e. Grinnell Corporation

2. Description:

a. Standard: MSS SP-70, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
c. NPS 14 to NPS 24, CWP Rating: 300 psig.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Disc: Solid wedge.
h. Packing and Gasket: Asbestos free.

B. Class 250, OS&Y, Iron Gate Valves:

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

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Powell Valves.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
h. Grinnell Corporation

2. Description:

a. Standard: MSS SP-70, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.

c. NPS 14 to NPS 24, CWP Rating: 300 psig.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Disc: Solid wedge.
h. Packing and Gasket: Asbestos free.

2.10 CHAINWHEELS

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

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.
3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.

2. Attachment: For connection to butterfly valve stems.

3. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve. Include zinc coating.

4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

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.

F. True Unions required.

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 chainwheels on operators for butterfly and gate valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Lift Check Valves: With stem upright and plumb.

G. Provide an additional six (6) valves of each type and size used in the project to accommodate interferences and/or as directed by Engineer.

3.3 ADJUSTING

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

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly or gate valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling Service: ball, or butterfly valves.
4. Pump-Discharge Check Valves:

    a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
    b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check valves.
    c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4 : Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze and Brass Valves: may be provided with solder-joint ends instead of threaded ends.

2. Ball Valves: One or Three piece, full port, brass with stainless-steel trim.
3. Bronze Swing Check Valves: Class 150, bronze disc.
4. Bronze Gate Valves: Class 150, NRS.

B. Pipe NPS 2-1/2 and Larger:

1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, stainless-steel disc.
2. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24: 150 CWP, EPDM seat, stainless-steel disc.
3. High-Performance Butterfly Valves: Class 150, single flange.

4. Iron Swing Check Valves: Class 250, metal seats.

5. Iron Gate Valves: Class 250, NRS or OS&Y.

3.6 SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Brass and Bronze Valves: May be provided with solder-joint ends instead of threaded ends.

2. Ball Valves: One or Three piece, full port, brass with stainless-steel trim.

3. Bronze Swing Check Valves: Class 150, bronze disc.
4. Bronze Gate Valves: Class 150, [NRS, bronze.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.

2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, stainless-steel disc.
3. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24: 150 CWP, EPDM seat, stainless-steel disc.
4. High-Performance Butterfly Valves: Class 150, single flange.

5. Iron Swing Check Valves: Class 250, metal seats.

6. Iron Gate Valves: Class 250, NRS or OS&Y.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal-hanger shield inserts.
7. Fastener systems.
8. Pipe stands.
9. Pipe positioning systems.
10. Equipment supports.

B. Related Sections:

1. Division 21 fire-suppression piping Sections for pipe hangers for fire-suppression piping.
2. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
3. Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, 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: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.
5. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

D. 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 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel .

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel

2.2 TRAPEZE PIPE HANGERS

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

2.3 FIBERGLASS PIPE HANGERS

A. Clevis-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 1, steel pipe hanger except hanger is made of fiberglass or fiberglass-reinforced resin.

2. Hanger Rods: Continuous-thread rod, washer, and nuts made of stainless steel

B. Strap-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 9 or Type 10, steel pipe hanger except hanger is made of fiberglass-reinforced resin.

2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

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

    a. Allied Tube & Conduit.
    b. Cooper B-Line, Inc.
    c. Flex-Strut Inc.
    d. GS Metals Corp.
    e. Thomas & Betts Corporation.
    f. Unistrut Corporation; Tyco International, Ltd.
    g. Wesanco, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel

7. Metallic Coating: Electroplated zinc

2.5 THERMAL-HANGER SHIELD INSERTS

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

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.7 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.8 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.9 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.10 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi , 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. 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. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.

F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

G. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) 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.

H. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.

I. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.

J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

L. 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.

M. Install lateral bracing with pipe hangers and supports to prevent swaying.

N. 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.

O. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

Q. 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 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2 : 12 inches long and 0.048 inch thick.
b. NPS 4 : 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6 : 18 inches long and 0.06 inch thick.
d. NPS 8 to NPS 14 24 inches long and 0.075 inch thick.
e. NPS 16 to NPS 24 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 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 bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches .

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils .

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

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. 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 metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 .
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24 requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 .
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 .
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): 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.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb
    b. Medium (MSS Type 32): 1500 lb
    c. Heavy (MSS Type 33): 3000 lb

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.

2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches .
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Restraining braces.

1.2 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.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: 2021.

2. Assigned Seismic Use Group or Building Category as Defined in the IBC: 2021 NJ Edition.

a. Component Importance Factor: as required by IBC 2021 NJ Edition.
b. Component Response Modification Factor: as required by IBC 2021 NJ Edition.
c. Component Amplification Factor: as required by IBC 2021 NJ Edition.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): as required by IBC 2021 NJ Edition.
4. Design Spectral Response Acceleration at 1-Second Period: as required by IBC 2021 Edition.

1.4 SUBMITTALS

A. Product Data: For each product indicated.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation and licensed in the State of New Jersey.

C. Welding certificates.

D. Qualification Data: For professional engineer.

1.5 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC and NFPA 13 unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

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

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Mason Industries.

7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Restrained Mounts: All-directional mountings with seismic restraint.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

2.2 SEISMIC-RESTRAINT DEVICES

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

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti, Inc.
5. Kinetics Noise Control.
6. Loos & Co.; Cableware Division.
7. Mason Industries.
8. TOLCO Incorporated; a brand of NIBCO INC.

9. Unistrut; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

E. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

G. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

PART 3 - EXECUTION

3.1 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127 and NFPA 13.

2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

C. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

D. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

F. Drilled-in Anchors:

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. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.2 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 22 Section "Domestic Water Piping" for piping flexible connections.

B. Submittals to be provided including isolators.

END OF SECTION 220548

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. 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.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White

C. Background Color: Red

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger

lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass beaded chain.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 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 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting".

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:

1. Domestic Water Piping(Label piping as CWS, HWS, HWR):

a. Background Color: White
b. Letter Color: Blue

2. Sanitary Waste and Storm Drainage Piping:

a. Background Color: Black
b. Letter Color: White

3. Compressed Air Piping:

a. Background Color: White
b. Letter Color: Green

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; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Cold Water: 2 inches , round
b. Hot Water: 2 inches , round

2. Valve-Tag Color:

a. Cold Water: Green
b. Hot Water: Green

3. Letter Color:

a. Cold Water: White
b. Hot Water: White

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220700 - PLUMBING 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. Calcium silicate.
b. Cellular glass.
c. Flexible elastomeric.
d. Mineral fiber.
e. Phenolic.
f. Polyisocyanurate.
g. Polyolefin.
h. Polystyrene.

2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied cloths.
10. Field-applied jackets.
11. Tapes.
12. Securements.
13. Corner angles.

B. Related Sections include the following:

1. Division 23 Section "HVAC Insulation."

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).

1. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.

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. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Sample Sizes:

a. Preformed Pipe Insulation Materials: 12 inches long by NPS 2 .
b. Sheet Form Insulation Materials: 12 inches square.
c. Jacket Materials for Pipe: 12 inches long by NPS 2 .
d. Sheet Jacket Materials: 12 inches square.
e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

D. Qualification Data: For qualified Installer.

E. 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.

F. 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.

C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Piping Mockups:

    a. One 10-foot section of NPS 2 straight pipe.
    b. One each of a 90-degree threaded, welded, and flanged elbow.
    c. One each of a threaded, welded, and flanged tee fitting.
    d. One NPS 2or smaller valve, and one NPS 2-1/2 or larger valve.
    e. Four support hangers including hanger shield and insert.
    f. One threaded strainer and one flanged strainer with removable portion of insulation.
    g. One threaded reducer and one welded reducer.
    h. One pressure temperature tap.
    i. One mechanical coupling.

2. Equipment Mockups: One tank or vessel.
3. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
4. Notify Architect seven days in advance of dates and times when mockups will be constructed.
5. Obtain Architect's approval of mockups before starting insulation application.

6. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
8. Demolish and remove mockups when directed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 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.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

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

    a. Cell-U-Foam Corporation; Ultra-CUF.
    b. Pittsburgh Corning Corporation; Foamglas Super K.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.

5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

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

    a. Aeroflex USA Inc.; Aerocel.
    b. Armacell LLC; AP Armaflex.
    c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

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

    a. CertainTeed Corp.; Duct Wrap.
    b. Johns Manville; Microlite.
    c. Knauf Insulation; Duct Wrap.
    d. Manson Insulation Inc.; Alley Wrap.
    e. Owens Corning; All-Service Duct Wrap.

I. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

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

    a. CertainTeed Corp.; Commercial Board.
    b. Fibrex Insulations Inc.; FBX.
    c. Johns Manville; 800 Series Spin-Glas.
    d. Knauf Insulation; Insulation Board.
    e. Manson Insulation Inc.; AK Board.
    f. Owens Corning; Fiberglas 700 Series.

J. Mineral-Fiber, Preformed Pipe Insulation:

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

    a. Fibrex Insulations Inc.; Coreplus 1200.
    b. Johns Manville; Micro-Lok.
    c. Knauf Insulation; 1000(Pipe Insulation.
    d. Manson Insulation Inc.; Alley-K.
    e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

K. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 3 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

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

    a. CertainTeed Corp.; CrimpWrap.
    b. Johns Manville; MicroFlex.
    c. Knauf Insulation; Pipe and Tank Insulation.
    d. Manson Insulation Inc.; AK Flex.
    e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

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

    a. Insulco, Division of MFS, Inc.; Triple I.
    b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

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

    a. Insulco, Division of MFS, Inc.; SmoothKote.
    b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
    c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

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

    a. Childers Products, Division of ITW; CP-96.
    b. Foster Products Corporation, H. B. Fuller Company; 81-33.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

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

    a. Aeroflex USA Inc.; Aeroseal.
    b. Armacell LCC; 520 Adhesive.
    c. Foster Products Corporation, H. B. Fuller Company; 85-75.
    d. RBX Corporation; Rubatex Contact Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

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

    a. Childers Products, Division of ITW; CP-82.

b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

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

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. PVC Jacket Adhesive: Compatible with PVC jacket.

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

a. Dow Chemical Company (The); 739, Dow Silicone.
b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Speedline Vinyl Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content in compliance with 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

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

    a. Childers Products, Division of ITW; CP-35.
    b. Foster Products Corporation, H. B. Fuller Company; 30-90.
    c. ITW TACC, Division of Illinois Tool Works; CB-50.
    d. Marathon Industries, Inc.; 590.
    e. Mon-Eco Industries, Inc.; 55-40.
    f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

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

    a. Childers Products, Division of ITW; CP-30.
    b. Foster Products Corporation, H. B. Fuller Company; 30-35.
    c. ITW TACC, Division of Illinois Tool Works; CB-25.
    d. Marathon Industries, Inc.; 501.
    e. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

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

    a. Childers Products, Division of ITW; Encacel.
    b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
    c. Marathon Industries, Inc.; 570.
    d. Mon-Eco Industries, Inc.; 55-70.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

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

a. Childers Products, Division of ITW; CP-10.
b. Foster Products Corporation, H. B. Fuller Company; 35-00.
c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
d. Marathon Industries, Inc.; 550.
e. Mon-Eco Industries, Inc.; 55-50.
f. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-76.
b. Foster Products Corporation, H. B. Fuller Company; 30-45.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Pittsburgh Corning Corporation; Pittseal 444.
f. Vimasco Corporation; 750.

B. FSK and Metal Jacket Flashing Sealants:

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

a. Childers Products, Division of ITW; CP-76-8.
b. Foster Products Corporation, H. B. Fuller Company; 95-44.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F
5. Color: Aluminum.

6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

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

a. Childers Products, Division of ITW; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F
5. Color: White.

6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

4. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

5. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

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

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto PVC Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.

3. Color: White Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

4. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:

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

a. Childers Products, Division of ITW; Metal Jacketing Systems.

b. PABCO Metals Corporation; Surefit.
c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209 Alloy 3003, 3005, 3105 or 5005, Temper H-14.

a. Factory cut and rolled to size.
b. Finish and thickness are indicated in field-applied jacket schedules.

c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

D. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

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

a. Pittsburgh Corning Corporation; Pittwrap.
b. Polyguard; Insulrap No Torch 125.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

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

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches .
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

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

    a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    b. Compac Corp.; 110 and 111.
    c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
    d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches .
3. Thickness: 6.5 mils .
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

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

    a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
    b. Compac Corp.; 130.
    c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
    d. Venture Tape; 1506 CW NS.

2. Width: 2 inches .
3. Thickness: 6 mils .
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

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

    a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    b. Compac Corp.; 120.
    c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    d. Venture Tape; 3520 CW.

2. Width: 2 inches .
3. Thickness: 3.7 mils .
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.

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

a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.

2. Width: 3 inches
3. Film Thickness: 6 mils
4. Adhesive Thickness: 1.5 mils
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

2.9 SECUREMENTS

A. Bands:

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

a. Childers Products; Bands.
b. PABCO Metals Corporation; Bands.
c. RPR Products, Inc.; Bands.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 0.015 inch thick, 3/4 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209 , Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.

4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.

2. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; CD.
3) Midwest Fasteners, Inc.; CD.

4) Nelson Stud Welding; TPA, TPC, and TPS.

3. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; Cupped Head Weld Pin.
      3) Midwest Fasteners, Inc.; Cupped Head.
      4) Nelson Stud Welding; CHP.

4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) AGM Industries, Inc.; RC-150.
      2) GEMCO; R-150.
      3) Midwest Fasteners, Inc.; WA-150.
      4) Nelson Stud Welding; Speed Clips.

   b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

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

D. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized steel.

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

   a. C & F Wire.
   b. Childers Products.
   c. PABCO Metals Corporation.
   d. RPR Products, Inc.

2.10 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch , aluminum according to ASTM B 209 , Alloy 3003, 3005, 3105 or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch , stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment 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 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. Provide an additional one hundred feet of preformed insulation and fifty square feet of blanket and board type insulation as well as accessories and labor for each size, thickness and type used on the project to accommodate any changes required to resolve interferences or as directed by the Engineer.

J. Install insulation with least number of joints practical.

K. 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.

L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

M. 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 4 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 pipe flanges and fittings.

N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

P. 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.

Q. 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.

1. Comply with requirements in Division 07 Section "Penetration Firestopping"irestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.

4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    d. Do not overcompress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins and attach speed washers.
    g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

    1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
    2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch-diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from aluminum, at least 0.060 inch thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.6 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 (50 mm) 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.

3.7 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch , and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.8 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.10 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch-circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.11 FINISHES

A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.12 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. Inspect field-insulated equipment, randomly selected by the Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to ten location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to ten locations of straight pipe, ten locations of threaded fittings, ten locations of welded fittings, five locations of threaded strainers, five locations of welded strainers, five locations of threaded valves, and five locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.13 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

C. Domestic water pump insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.

D. Domestic chilled-water (potable) pump insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.

E. Domestic hot-water pump insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.

F. Domestic water, domestic chilled-water (potable), and domestic hot-water hydropneumatic tank insulation shall be the following:

1. Mineral-Fiber Pipe and Tank: 2 inches thick.

G. Domestic hot-water storage tank insulation shall be the following, of thickness to provide an R-value of 12.5:
   1. Mineral-fiber pipe and tank.

H. Domestic water storage tank insulation shall be the following:

   1. Mineral-Fiber Pipe and Tank: 2 inches thick.

I. Domestic chilled-water (potable) storage tank insulation shall be the following:

   1. Mineral-Fiber Pipe and Tank: 2 inches thick.

J. Piping system filter-housing insulation shall be the following:

   1. Mineral-Fiber Pipe and Tank: 2 inches thick.

3.14 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

   1. Drainage piping located in crawl spaces.
   2. Underground piping.
   3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.15 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

   1. NPS 1 and Smaller: Insulation shall be the following:

      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

   2. NPS 1-1/4 and Larger: Insulation shall be the following:

      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

B. Domestic Hot and Recirculated Hot Water:

   1. NPS 1-1/4 and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

2. NPS 1-1/2 and Larger: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

C. Domestic Chilled Water (Potable):

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

D. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

E. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

F. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

G. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

H. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1- inch thick.

I. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

J. Hot Service Drains:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type I or II: 1-1/2 inches thick.

3.16 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

B. Domestic Hot and Recirculated Hot Water:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

C. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

D. Hot Service Drains:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

3.17 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

A. Loose-fill insulation, for belowground piping, is specified in Division 33 piping distribution Sections.

B. Sanitary Waste Piping, All Sizes, Where Heat Tracing Is Installed: Cellular glass, 2 inches thick.

C. Chilled Domestic Water, All Sizes: Cellular glass, 2 inches thick.

3.18 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Equipment, Concealed:

1. Paper & Foil with Vapor Retarder

D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches :

1. PVC 30 mils thick.

E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches :

1. Painted Aluminum Smooth 0.032 inch thick.

F. Piping, Concealed:

1. Paper & Foil with Vapor Retarder

G. Piping, Exposed:

1. PVC 30 mils thick

3.19 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Equipment, Concealed:

1. Aluminum, Smooth 0.040 inch thick.

D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches :

1. Aluminum, Smooth 0.040 inch thick.

E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches

1. Aluminum, Smooth 0.040 inch thick.

F. Piping, Concealed:

1. Aluminum, Smooth 0.040 inch thick.

G. Piping, Exposed:

1. Aluminum, Smooth 0.040 inch thick.

3.20 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220700

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Encasement for piping.
3. Specialty valves.
4. Flexible connectors.

5. Water meters furnished by utility company for installation by Contractor.
6. Water meters.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to ASCE/SEI 7.

B. Performance Requirements: Provide components and installation capable of producing domestic water piping systems with the following minimum working-pressure ratings, unless otherwise indicated:

1. Domestic Water Service Piping: 160 psig.
2. Domestic Water Distribution Piping: 125 psig.

1.4 SUBMITTALS

A. Product Data: For the following products:

1. Specialty valves.
2. Transition fittings.
3. Dielectric fittings.
4. Flexible connectors.

5. Water meters.
6. Backflow preventers and vacuum breakers.

7. Water penetration systems.

B. Water Samples: Specified in "Cleaning" Article.

C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Fire-suppression-water piping.
2. Domestic water piping.
3. Compressed air piping.
4. HVAC equipment.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61 for potable domestic water piping and components.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Do not proceed with interruption of water service without Architect's, Construction Manager's, Engineers and Owner's written permission.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.

2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

B. Soft Copper Tube: ASTM B 88, Type L water tube, annealed temper.

1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.3 PIPING JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.4 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Form: Tube.

C. Material: High-density, cross-laminated PE film of 0.004-inch minimum thickness.

D. Color: Black.

2.5 SPECIALTY VALVES

A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.

B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.6 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.

2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

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

a. Cascade Waterworks Manufacturing.
b. Dresser, Inc.; Dresser Piping Specialties.
c. Ford Meter Box Company, Inc. (The).
d. JCM Industries.
e. Romac Industries, Inc.
f. Smith-Blair, Inc; a Sensus company.
g. Viking Johnson; c/o Mueller Co.

D. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. Charlotte Pipe and Foundry Company.
b. Harvel Plastics, Inc.
c. Spears Manufacturing Company.

2. Description: CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket[or threaded] end.

E. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

a. Colonial Engineering, Inc.
b. NIBCO INC.
c. Spears Manufacturing Company.

2. Description: CPVC or PVC four-part union. Include brass[or stainless-steel] threaded end, solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

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

    a. Capitol Manufacturing Company.
    b. Central Plastics Company.
    c. EPCO Sales, Inc.
    d. Hart Industries International, Inc.
    e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    f. Zurn Plumbing Products Group; Wilkins Water Control Products.

2. Description:

    a. Pressure Rating: 150 psig at 180 deg F.
    b. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

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

    a. Capitol Manufacturing Company.
    b. Central Plastics Company.
    c. EPCO Sales, Inc.
    d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

    a. Factory-fabricated, bolted, companion-flange assembly.

    b. Pressure Rating: 150 psig minimum.
    c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:

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

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.

c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Description:

a. Nonconducting materials for field assembly of companion flanges.

b. Pressure Rating: 150 psig.
c. Gasket: Neoprene or phenolic.
d. Bolt Sleeves: Phenolic or polyethylene.
e. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

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

a. Calpico, Inc.
b. Lochinvar Corporation.

2. Description:

a. Galvanized-steel coupling.

b. Pressure Rating: 300 psig at 225 deg F.
c. End Connections: Female threaded.
d. Lining: Inert and noncorrosive, thermoplastic.

F. Dielectric Nipples:

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

a. Perfection Corporation; a subsidiary of American Meter Company.
b. Precision Plumbing Products, Inc.
c. Victaulic Company.

2. Description:

a. Electroplated steel nipple complying with ASTM F 1545.
b. Pressure Rating: 300 psig at 225 deg F.
c. End Connections: Male threaded or grooved.
d. Lining: Inert and noncorrosive, propylene.

2.8 FLEXIBLE CONNECTORS

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

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Flex Pression, Ltd.
4. Flex-Weld, Inc.
5. Hyspan Precision Products, Inc.
6. Mercer Rubber Co.
7. Metraflex, Inc.
8. Proco Products, Inc.
9. Tozen Corporation.
10. Unaflex, Inc.
11. Universal Metal Hose; a Hyspan company

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.9 WATER METERS

A. Displacement-Type Water Meters:

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

a. AALIANT; a Venture Measurement Product Line.
b. ABB.
c. Badger Meter, Inc.
d. Carlon Meter.
e. Mueller Company; Water Products Division.
f. Schlumberger Limited; Water Division.
g. Sensus Metering Systems.

2. Description:

a. Standard: AWWA C700.
b. Pressure Rating: 150-psig working pressure.
c. Body Design: Nutating disc; totalization meter.

d. Registration: In gallons or cubic feet as required by utility.
e. Case: Bronze.
f. End Connections: Threaded.

B. Turbine-Type Water Meters:

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

a. AALIANT; a Venture Measurement Product Line.
b. ABB.
c. Badger Meter, Inc.
d. Hays Fluid Controls.
e. Master Meter, Inc.
f. McCrometer.
g. Mueller Company; Water Products Division.
h. Schlumberger Limited; Water Division.
i. SeaMetrics Inc.
j. Sensus Metering Systems.

2. Description:

a. Standard: AWWA C701.
b. Pressure Rating: 150-psig working pressure.
c. Body Design: Turbine; totalization meter.
d. Registration: In gallons or cubic feet as required by utility company .
e. Case: Bronze.
f. End Connections for Meters NPS 2 and Smaller: Threaded.
g. End Connections for Meters NPS 2-1/2 and Larger: Flanged.

C. Compound-Type Water Meters:

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

a. ABB.
b. Badger Meter, Inc.
c. Master Meter, Inc.
d. Mueller Company; Water Products Division.
e. Schlumberger Limited; Water Division.
f. Sensus Metering Systems.

2. Description:

a. Standard: AWWA C702.
b. Pressure Rating: 150-psig working pressure.
c. Body Design: With integral mainline and bypass meters; totalization meter.
d. Registration: In gallons or cubic feet as required by utility company.

e. Case: Bronze.
f. Pipe Connections: Flanged.

D. Fire-Service-Type Water Meters:

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

a. Badger Meter, Inc.
b. Mueller Company; Water Products Division.
c. Schlumberger Limited; Water Division.
d. Sensus Metering Systems.

2. Description:

a. Standard: AWWA C703 and UL listing.
b. Pressure Rating: 175-psig working pressure.
c. Body Design:

1) Proportional, Detector-Type Water Meters: With meter on bypass.

a) Bypass Meter: AWWA C701, turbine or AWWA C702, compound type with bronze case; size not less than one-half nominal size of main-line meter.

2) Turbine-Type Water Meters: With strainer, and with meter on bypass.

a) Strainer: Full size, matching water meter.
b) Bypass Meter: AWWA C701, turbine type with bronze case; not less than NPS 2.

d. Registration: In gallons or cubic feet as required by utility company.
e. Case: Bronze.
f. Pipe Connections for Meters NPS 2 and Smaller: Threaded.
g. Pipe Connections for Meters NPS 2-1/2 and Larger: Flanged.

E. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

F. Remote Registration System: Encoder type complying with AWWA C707; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105.

D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.

E. Install shutoff valve immediately upstream of each dielectric fitting.

F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.

G. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

I. Install seismic restraints on piping. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

K. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

M. Install piping adjacent to equipment and specialties to allow service and maintenance.

N. Install piping to permit valve servicing.

O. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

P. Install piping free of sags and bends.

Q. Provide an additional one hundred feet of piping and accessories and labor for each size of pipe used on the project to accommodate any changes required to resolve interferences or as directed by the Engineer.

R. Install fittings for changes in direction and branch connections.

S. Install PEX piping with loop at each change of direction of more than 90 degrees.

T. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

U. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.

V. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.

W. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

X. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

Y. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

Z. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

3.4 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."

1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.5 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. NPS 1-1/2 and Smaller: Fitting-type coupling.
2. NPS 2 and Larger: Sleeve-type coupling.

3.6 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.7 FLEXIBLE CONNECTOR INSTALLATION

A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.

B. Install bronze-hose flexible connectors in copper domestic water tubing.

C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.8 WATER METER INSTALLATION

A. Rough-in domestic water piping for water meter installation and install water meters according to utility company's requirements.

B. Water meters will be furnished and installed by utility company.

C. Install water meters according to AWWA M6, utility company's requirements, and the following:

D. Install displacement-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.

E. Install turbine-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.

F. Install compound-type water meters with shutoff valves on water-meter inlet and outlet and on valved bypass around meter. Support meters, valves, and piping on brick or concrete piers.

G. Install fire-service water meters with shutoff valves on water-meter inlet and outlet and on full-size valved bypass around meter. Support meter, valves, and piping on brick or concrete piers.

H. Install remote registration system according to standards of utility company and of authorities having jurisdiction.

3.9 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.
3. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
5. NPS 6: 48 inches with 3/4-inch rod.
6. NPS 8: 48 inches with 7/8-inch rod.

J. 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.

K. 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.

L. Install hangers for vertical PEX piping every 48 inches.

M. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2 and Smaller: 48 inches with 3/8-inch rod.
2. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6: 48 inches with 3/4-inch rod.
5. NPS 8: 48 inches with 7/8-inch rod.

N. Install supports for vertical PVC piping every 48 inches.

O. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.10 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.11 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.12 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

    a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 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.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.13 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.14 CLEANING

A. Clean and disinfect potable and non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.15 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

1. Underground Domestic Water piping materials shall match those used for the underground site main to the building Soft copper tube, ASTM B 88, Type L; wrought-copper solder-joint fittings and brazed joints.

D. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; wrought-copper solder-joint fittings; and soldered joints.

E. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; wrought-copper solder-joint fittings; and soldered joints.

F. Aboveground domestic water piping, NPS 5 to NPS 8, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; wrought-copper solder-joint fittings; and soldered joints.

G. Underground Domestic Water piping materials shall match those used for the underground site main to the building:

3.16 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
3. Hot-Water Circulation Piping, Balancing Duty: [Calibrated] [Memory-stop] balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated water mixing valves.
6. Strainers.
7. Outlet boxes.
8. Hose stations.
9. Hose bibbs.
10. Wall hydrants.
11. Ground hydrants.
12. Post hydrants.
13. Drain valves.
14. Water hammer arresters.
15. Air vents.
16. Trap-seal primer valves.
17. Trap-seal primer systems.

B. Related Sections include the following:

1. Division 22 Section "Domestic Water Piping" for water meters.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

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

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Ames Co.
    b. Cash Acme.
    c. Conbraco Industries, Inc.
    d. FEBCO; SPX Valves & Controls.
    e. Rain Bird Corporation.
    f. Toro Company (The); Irrigation Div.
    g. Watts Industries, Inc.; Water Products Div.
    h. Zurn Plumbing Products Group; Wilkins Div.

3. Standard: ASSE 1001.
4. Size: NPS 1/4 to NPS 3, as required to match connected piping.
5. Body: Bronze.
6. Inlet and Outlet Connections: Threaded.

7. Finish: Rough bronze or Chrome plated.

B. Hose-Connection Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Arrowhead Brass Products, Inc.
    b. Cash Acme.
    c. Conbraco Industries, Inc.
    d. Legend Valve.
    e. MIFAB, Inc.
    f. Prier Products, Inc.
    g. Watts Industries, Inc.; Water Products Div.
    h. Woodford Manufacturing Company.
    i. Zurn Plumbing Products Group; Light Commercial Operation.
    j. Zurn Plumbing Products Group; Wilkins Div.

3. Standard: ASSE 1011.
4. Body: Bronze, nonremovable, with manual drain.
5. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
6. Finish: Chrome, nickel plated or rough bronze.

C. Pressure Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide by one of the following:

    a. Ames Co.
    b. Conbraco Industries, Inc.
    c. FEBCO; SPX Valves & Controls.
    d. Flomatic Corporation.
    e. Toro Company (The); Irrigation Div.
    f. Watts Industries, Inc.; Water Products Div.
    g. Zurn Plumbing Products Group; Wilkins Div.

4. Standard: ASSE 1020.
5. Operation: Continuous-pressure applications.
6. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
7. Accessories:

a. Valves: Ball type, on inlet and outlet.

D. Laboratory-Faucet Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.
b. Watts Industries, Inc.; Water Products Div.
c. Woodford Manufacturing Company.
d. Zurn Plumbing Products Group; Wilkins Div.

3. Standard: ASSE 1035.
4. Size: NPS 1/4 or NPS 3/8 matching faucet size.
5. Body: Bronze.
6. End Connections: Threaded.
7. Finish: Chrome plated.

E. Spill-Resistant Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.
b. Watts Industries, Inc.; Water Products Div.

3. Standard: ASSE 1056.
4. Operation: Continuous-pressure applications.
5. Accessories:

a. Valves: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

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

a. Ames Co.
b. Conbraco Industries, Inc.

c. FEBCO; SPX Valves & Controls.
d. Flomatic Corporation.
e. Watts Industries, Inc.; Water Products Div.
f. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight through flow.
8. Accessories:

a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Double-Check Backflow-Prevention Assemblies:

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

a. Ames Co.
b. Conbraco Industries, Inc.
c. FEBCO; SPX Valves & Controls.
d. Flomatic Corporation.
e. Watts Industries, Inc.; Water Products Div.
f. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller; [cast iron with interior lining complying with AWWA C550 or that is FDA approved] [steel with interior lining complying with AWWA C550 or that is FDA approved] [stainless steel] for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; [flanged] <Insert type> for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight through flow.
8. Accessories:

a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

C. Reduced-Pressure-Detector, Fire-Protection Backflow-Preventer Assemblies:

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

a. Ames Co.
b. Conbraco Industries, Inc.
c. FEBCO; SPX Valves & Controls.
d. Watts Industries, Inc.; Water Products Div.
e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1047 and FMG approved or UL listed.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved].
6. End Connections: Flanged.
7. Configuration: Designed for horizontal, straight through flow.
8. Accessories:

a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

D. Double-Check, Detector-Assembly Backflow Preventers:

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

a. Ames Co.
b. Conbraco Industries, Inc.
c. FEBCO; SPX Valves & Controls.
d. Watts Industries, Inc.; Water Products Div.
e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1048 and FMG approved or UL listed.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved.
6. End Connections: Flanged.

7. Configuration: Designed for horizontal, straight through flow.
8. Accessories:

    a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
    b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

E. Backflow-Preventer Test Kits:

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

    a. Conbraco Industries, Inc.
    b. FEBCO; SPX Valves & Controls.
    c. Flomatic Corporation.
    d. Watts Industries, Inc.; Water Products Div.
    e. Zurn Plumbing Products Group; Wilkins Div.

2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

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

    a. Cash Acme.
    b. Conbraco Industries, Inc.
    c. Honeywell Water Controls.
    d. Watts Industries, Inc.; Water Products Div.
    e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
5. Valves for Booster Heater Water Supply: Include integral bypass.

6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Water Control Valves:

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

    a. CLA-VAL Automatic Control Valves.
    b. Flomatic Corporation.
    c. OCV Control Valves.
    d. Watts Industries, Inc.; Ames Fluid Control Systems.
    e. Watts Industries, Inc.; Watts ACV.
    f. Zurn Plumbing Products Group; Wilkins Div.

2. Description: Pilot-operation, diaphragm-type, single-seated main water control valve.
3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.

    a. Pattern: Angle or Globe-valve design
    b. Trim: Stainless steel.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

2.4 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

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

    a. Armstrong International, Inc.
    b. Flo Fab Inc.
    c. ITT Industries; Bell & Gossett Div.
    d. NIBCO INC.
    e. TAC Americas.
    f. Taco, Inc.
    g. Watts Industries, Inc.; Water Products Div.

2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: Brass or bronze,

4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves:

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

    a. Armstrong International, Inc.
    b. Flo Fab Inc.
    c. ITT Industries; Bell & Gossett Div.
    d. NIBCO INC.
    e. TAC Americas.
    f. Watts Industries, Inc.; Water Products Div.

2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
3. Size: Same as connected piping, but not smaller than NPS 2-1/2.

C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

D. Memory-Stop Balancing Valves:

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

    a. Conbraco Industries, Inc.
    b. Crane Co.; Crane Valve Group; Crane Valves.
    c. Crane Co.; Crane Valve Group; Jenkins Valves.
    d. Crane Co.; Crane Valve Group; Stockham Div.
    e. Hammond Valve.
    f. Milwaukee Valve Company.
    g. NIBCO INC.
    h. Red-White Valve Corp.

2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

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

a. Armstrong International, Inc.
b. Cash Acme.
c. Conbraco Industries, Inc.
d. Honeywell Water Controls.
e. Legend Valve.
f. Leonard Valve Company.
g. Powers; a Watts Industries Co.
h. Symmons Industries, Inc.
i. Taco, Inc.
j. Watts Industries, Inc.; Water Products Div.
k. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Finish: Chrome plated or Rough bronze.

B. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2.

a. Armstrong International, Inc.
b. Lawler Manufacturing Company, Inc.
c. Leonard Valve Company.
d. Powers; a Watts Industries Co.
e. Symmons Industries, Inc.

3. Standard: ASSE 1017.
4. Pressure Rating: 125 psig.
5. Type: Exposed-mounting, thermostatically controlled water mixing valve.
6. Material: Bronze body with corrosion-resistant interior components.
7. Connections: Threaded inlets and outlet.
8. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
9. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
10. Pressure Drop at Design Flow Rate: 15 psig.
11. Valve Finish: Chrome plated or Rough bronze.
12. Piping Finish: Copper.

C. Manifold, Thermostatic, Water-Mixing-Valve Assemblies:

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

    a. Leonard Valve Company.
    b. Powers; a Watts Industries Co.
    c. Symmons Industries, Inc.

2. Description: Factory-fabricated, exposed-mounting, thermostatically controlled, water-mixing-valve assembly in three-valve parallel arrangement.
3. Large-Flow Parallel: Thermostatic water mixing valve and downstream pressure regulator with pressure gages on inlet and outlet.

4. Intermediate-Flow Parallel: Thermostatic water mixing valve and downstream pressure regulator with pressure gages on inlet and outlet.
5. Small-Flow Parallel: Thermostatic water mixing valve.
6. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.
7. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
8. Component Pressure Ratings: 125 psig minimum, unless otherwise indicated.

9. Cabinet: Factory-fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.
10. Unit Pressure Drop at Design Flow Rate: 15 psig.
11. Thermostatic Mixing Valve and Water Regulator Finish: Chrome plated or rough bronze.
12. Piping Finish: Copper.

D. Individual-Fixture, Water Tempering Valve:

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

    a. Cash Acme.
    b. Conbraco Industries, Inc.
    c. Honeywell Water Controls.
    d. Lawler Manufacturing Company, Inc.
    e. Leonard Valve Company.
    f. Powers; a Watts Industries Co.
    g. Watts Industries, Inc.; Water Products Div.
    h. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1016, thermostatically controlled water tempering valve.
3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.

E. Primary Water Tempering Valves:

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

   a. Heat-Timer Corporation.
   b. Holby Valve Co., Inc.

2. Standard: ASSE 1017, thermostatically controlled tempering valve, listed as tempering valve.
3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
4. Body: Bronze.
5. Temperature Control: Manual.
6. Inlets and Outlet: Threaded.
7. Valve Finish: Rough bronze.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller;flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.

5. Perforation Size:

   a. StrainersNPS 2 and Smaller: 0.033 inch.
   b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
   c. Strainers NPS 5 and Larger: 0.125 inch.

6. Drain: Factory-installed, hose-end drain valve.

2.7 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

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

   a. Acorn Engineering Company.
   b. Guy Gray Manufacturing Co., Inc.
   c. IPS Corporation.

d. LSP Products Group, Inc.
e. Oatey.
f. Plastic Oddities; a division of Diverse Corporate Technologies.
g. Symmons Industries, Inc.
h. Watts Industries, Inc.; Water Products Div.
i. Whitehall Manufacturing; a div. of Acorn Engineering Company.
j. Zurn Plumbing Products Group; Light Commercial Operation.

2. Mounting: Recessed.
3. Material and Finish: Stainless-steel box and faceplate.
4. Faucet: Combination, valved fitting or separate hot- and cold-water, valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
6. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.

7. Inlet Hoses: Two 60-inch- long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
8. Drain Hose: One 48-inch- long, rubber household clothes washer drain hose with hooked end.

B. Icemaker Outlet Boxes:

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

a. Acorn Engineering Company.
b. IPS Corporation.
c. LSP Products Group, Inc.
d. Oatey.
e. Plastic Oddities; a division of Diverse Corporate Technologies.

2. Mounting: Recessed.
3. Material and Finish: Stainless-steel box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.8 HOSE STATIONS

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

1. ARCHON Industries, Inc.
2. Armstrong International, Inc.

3. Cooney Brothers, Inc.
4. DynaFluid Ltd.
5. Leonard Valve Company.
6. Strahman Valves, Inc.
7. T & S Brass and Bronze Works, Inc.

B. Single-Temperature-Water Hose Stations:

1. Standard: ASME A112.18.1.
2. Cabinet: Stainless-steel enclosure with exposed valve handle, hose connection, and hose rack. Include thermometer in front.
3. Hose-Rack Material: Stainless steel.
4. Body Material: Bronze with stainless-steel wetted parts.
5. Body Finish: Rough bronze or chrome plated.
6. Mounting: Wall, with reinforcement.
7. Supply Fitting: NPS 3/4 gate, globe, or ball valve and check valve and NPS 3/4 copper, water tubing. Omit check valve if check stop is included with fitting.
8. Hose: Manufacturer's standard, for service fluid, temperature, and pressure; 50 feet long.
9. Nozzle: With hand squeeze on-off control.
10. Vacuum Breaker: Integral or factory-installed, nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052; and garden-hose thread complying with ASME B1.20.7 on outlet.

C. Hot- and Cold-Water Hose Stations:

1. Standard: ASME A112.18.1.
2. Type Faucet: Blending valve.
3. Cabinet: Stainless-steel enclosure with exposed valve handles, hose connection, and hose rack. Include thermometer in front.
4. Hose-Rack Material: Stainless steel.
5. Body Material: Bronze with stainless-steel wetted parts.
6. Body Finish: Rough bronze or chrome plate.
7. Mounting: Wall, with reinforcement.
8. Supply Fittings: TwoNPS 3/4 gate, globe, or ball valves and check valves and NPS 3/4 copper, water tubing. Omit check valves if check stops are included with fitting.
9. Hose: Manufacturer's standard, for service fluid, temperature, and pressure; 50 feet long.
10. Nozzle: With hand squeeze on-off control.
11. Vacuum Breaker: Integral or factory-installed, nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052; and garden-hose thread complying with ASME B1.20.7 on outlet.

2.9 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze, Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Wheel handle.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.10 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

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

    a. Josam Company.
    b. MIFAB, Inc.
    c. Prier Products, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Woodford Manufacturing Company.
    h. Zurn Plumbing Products Group; Light Commercial Operation.
    i. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.

9. Box and Cover Finish: Polished nickel bronze.

10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): Two with each wall hydrant.

2.11 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valve:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.12 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMTROL, Inc.
    b. Josam Company.
    c. MIFAB, Inc.
    d. PPP Inc.
    e. Sioux Chief Manufacturing Company, Inc.
    f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    g. Tyler Pipe; Wade Div.
    h. Watts Drainage Products Inc.
    i. Zurn Plumbing Products Group; Specification Drainage Operation.

3. Standard: ASSE 1010 or PDI-WH 201.
4. Type: Metal Bellows, see fixture schedule.
5. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.13 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 or NPS 1/2 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.

6. Inlet and Vent Outlet End Connections: Threaded.

2.14 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. MIFAB, Inc.
    b. PPP Inc.
    c. Sioux Chief Manufacturing Company, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    e. Watts Industries, Inc.; Water Products Div.

3. Standard: ASSE 1018.
4. Pressure Rating: 125 psig minimum.
5. Body: Bronze.
6. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
7. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
8. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

3. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
4. Size: NPS 1-1/4 minimum.
5. Material: Chrome-plated, cast brass.

2.15 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

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

    a. PPP Inc.

2. Standard: ASSE 1044,
3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
4. Cabinet: Recessed-mounting steel box with stainless-steel cover.

5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
6. Vacuum Breaker: ASSE 1001.
7. Number Outlets: Six.
8. Size Outlets: NPS 1/2.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

D. Install water control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.

E. Install balancing valves in locations where they can easily be adjusted.

F. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and water regulators if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified.

G. Install Y-pattern strainers for water on supply side of each control valve,water pressure-reducing valve, solenoid valve and pump].

H. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."

I. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.

1. Install shutoff valve on outlet if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."

J. Install ground hydrants with [1 cu. yd.] <Insert dimension> of crushed gravel around drain hole. Set ground hydrants with box flush with grade.

K. Install draining-type post hydrants with [1 cu. yd.] <Insert dimension> of crushed gravel around drain hole. Set post hydrants in concrete paving or in [1 cu. ft.] <Insert dimension> of concrete block at grade.

L. Install nonfreeze, nondraining-type post hydrants set in concrete or pavement.

M. Install freeze-resistant yard hydrants with riser pipe set in concrete or pavement. Do not encase canister in concrete.

N. Install water hammer arresters in water piping according to PDI-WH 201.

O. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

P. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

Q. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

R. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Reduced-pressure-principle backflow preventers.
3. Double-check backflow-prevention assemblies.
4. Dual-check-valve backflow preventers.
5. Double-check, detector-assembly backflow preventers.
6. Water pressure-reducing valves.
7. Calibrated balancing valves.
8. Primary, thermostatic, water mixing valves.
9. Manifold, thermostatic, water-mixing-valve assemblies.
10. Primary water tempering valves.
11. Outlet boxes.
12. Hose stations.
13. Supply-type, trap-seal primer valves.
14. Trap-seal primer systems.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following for soil, waste, and vent piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.
3. Encasement for underground metal piping.

B. Any sanitary piping located above a drop ceiling or within a wall adjacent to an occupied space is to be insulated cast iron.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. LLDPE: Linear, low-density polyethylene plastic.

D. NBR: Acrylonitrile-butadiene rubber.

E. PE: Polyethylene plastic.

F. PVC: Polyvinyl chloride plastic.

G. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Shop Drawings:

1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.

C. Coordination Drawings: Plans and details, drawn to scale, on which above and below ground sanitary and vent piping is shown and coordinated with other installations, using input from installers of the items involved. Clearly indicate all inverts and coordinate with site contractors.

D. 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-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.

C. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

a. Available Manufacturers:

1) ANACO.
2) Clamp-All Corp.
3) Ideal Div.; Stant Corp.
4) Mission Rubber Co.
5) Tyler Pipe; Soil Pipe Div.

2.5 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.

B. Drainage Fittings: ASME B16.12, threaded, cast-iron drainage pattern.

2.6 STAINLESS-STEEL PIPE AND FITTINGS

A. Pipe and Fittings: ASME A112.3.1, drainage pattern with socket and spigot ends.

B. Gaskets: Lip seals shaped to fit socket groove, with plastic backup ring.

1. Material: EPDM, unless NBR is indicated.

2.7 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Description: ASTM A 674 or AWWA C105, high-density, crosslaminated PE film of 0.004-inch minimum thickness.

B. Form: Sheet.

C. Color: Black.

PART 3 - EXECUTION

3.1 EXCAVATION

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

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings heavy-duty shielded, couplings; and hubless-coupling joints.

C. Aboveground, soil and waste piping NPS 5 and larger shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings and heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.

D. Aboveground, vent piping NPS 4 and smaller shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.

E. Aboveground, vent piping NPS 5 and larger shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.

F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.

G. Underground, soil and waste piping NPS 5 and larger shall be the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.

3.3 PIPING INSTALLATION

A. Sanitary sewer piping outside the building is specified in Division 22 Section "Facility Sanitary Sewers."

B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

C. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

E. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

F. Provide an additional one hundred feet of drainage and vent piping for each size used on the project to resolve interferences or as directed by the Engineer.

G. Install underground, steel, force-main piping. Install encasement on piping according to ASTM A 674 or AWWA C105.

H. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside the building between wall and floor penetrations and connection to sanitary sewer piping outside the building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

I. 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.

J. Install underground, ductile-iron, special pipe fittings according to AWWA C600.

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 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 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 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 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. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

O. Install engineered soil and waste drainage and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Sovent Drainage System: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

P. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

C. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Backwater Valves: Install backwater valves in piping subject to sewage backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Backwater valve are specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install individual, straight, horizontal piping runs according to the following:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6: 60 inches with 3/4-inch rod.
5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

I. Install supports for vertical steel piping every 15 feet.

J. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2: 84 inches with 3/8-inch rod.
2. NPS 3: 96 inches with 1/2-inch rod.
3. NPS 4: 108 inches with 1/2-inch rod.
4. NPS 6: 10 feet with 5/8-inch rod.

K. Install supports for vertical stainless-steel piping every 10 feet.

L. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

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 new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 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 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Trench drains.
4. Air-admittance valves.
5. Roof flashing assemblies.
6. Through-penetration firestop assemblies.
7. Miscellaneous sanitary drainage piping specialties.
8. Flashing materials.
9. Grease interceptors.
10. Grease removal devices.
11. Oil interceptors.
12. Solids interceptors.

B. Related Sections include the following:

1. Division 22 Section "Storm Drainage Piping Specialties" for trench drains for storm water, and catch basins.

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 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
   1. Grease interceptors.
   2. Grease removal devices.
   3. Oil interceptors.

B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.

   1. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that interceptors andaccessories, and components will withstand seismic forces defined in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:

   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
      b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

1.7 EXTRA MATERIALS

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

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

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

    a. Josam Company; Josam Div.
    b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    c. Tyler Pipe; Wade Div.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group; Specification Drainage Operation.

    f. Josam Company; Blucher-Josam Div.

2. Standard: ASME A112.36.2M for cast iron & ASME A112.3.1 for stainless steel 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: Countersun brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

7. Closure: Stainless-steel plug with seal.
8. See plumbing fixture schedule for additional requirements

B. Metal Floor Cleanouts:

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

   a. Josam Company; Josam Div.
   b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   c. Tyler Pipe; Wade Div.
   d. Watts Drainage Products Inc.
   e. Zurn Plumbing Products Group; Light Commercial Operation.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.

   g. Josam Company; Josam Div.

2. Standard: ASME A112.36.2M for cleanout.
3. Size: Same as connected branch.
4. Closure: Brass plug with straight threads and gasket
5. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

6. Standard: ASME A112.3.1.
7. Size: Same as connected branch.
8. Housing: Stainless steel.
9. Closure: Stainless steel with seal.
10. Riser: Stainless-steel drainage pipe fitting to cleanout.
11. See plumbing fixture schedule for additional requirements

C. Cast-Iron Wall Cleanouts

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

   a. Josam Company; Josam Div.
   b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   c. Tyler Pipe; Wade Div.
   d. Watts Drainage Products Inc.
   e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: As required to match connected piping.

5. Closure: Countersunk brass plug.

6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

8. Wall Access: Round stainless-steel wall-installation frame and cover.
9. See plumbing fixture schedule for additional requirements

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company; Josam Div.
   b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   c. Tyler Pipe; Wade Div.
   d. Watts Drainage Products Inc.
   e. Zurn Plumbing Products Group; Light Commercial Operation.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3.
3. Body Material: See Fixture Schedule.
4. Seepage Flange: See Fixture Schedule
5. Anchor Flange: See Fixture Schedule.
6. Clamping Device: See Fixture Schedule.
7. Outlet: Bottom

8. Trap Pattern: Deep-seal P-trap
9. See plumbing fixture schedule for additional requirements

2.3 TRENCH DRAINS

A. Trench Drains

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

   a. Josam Company; Josam Div.
   b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   c. Tyler Pipe; Wade Div.
   d. Watts Drainage Products Inc.
   e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3 for trench drains.
3. Material: Ductile or gray iron.
4. Outlet: See drawings
5. See plumbing fixture schedule for additional requirements

2.4 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies

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

    a. Acorn Engineering Company; Elmdor/Stoneman Div.
    b. Thaler Metal Industries Ltd.

B. Description: Lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

1. Open-Top Vent Cap: Without cap.
2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. ProSet Systems Inc.

2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.

5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.

6. Special Coating: Corrosion resistant on interior of fittings.

2.6 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

a. NPS 2: 4-inch- minimum water seal.
b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

B. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

C. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

D. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

E. Stack Flashing Fittings

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

F. Vent Caps

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Frost-Resistant Vent Terminals

1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

H. Expansion Joints

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.7 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft. thickness.
2. Vent Pipe Flashing: 8 oz./sq. ft. thickness.

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 CONCRETE BASES

A. Anchor grease interceptors and solids interceptors to concrete bases.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 19-inch centers around full perimeter of base.

2. For installed equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be imbedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

5. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
6. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.2 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backwater valves in building drain piping where noted. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

C. 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.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

a. Radius, 30 Inches or Less: Equivalent to 1 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.

G. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.

H. 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.

I. Assemble non-ASME A112.3.1, stainless-steel channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

J. Assemble FRP channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

K. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

L. Install fixture air-admittance valves on fixture drain piping.

M. Install stack air-admittance valves at top of stack vent and vent stack piping.

N. Install air-admittance-valve wall boxes recessed in wall.

O. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

P. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

Q. Install through-penetration firestop assemblies in plastic at floor penetrations.

R. Assemble open drain fittings and install with top of hub 2 inches above floor.

S. Install deep-seal traps on floor drains and other waste outlets, if indicated.

T. 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.

U. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

V. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

W. Install vent caps on each vent pipe passing through roof.

X. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

Y. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

Z. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

AA. Install cleanout immediately downstream from all interceptors that do not have integral cleanout on outlet. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.

BB. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.5 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. Oil interceptors.
2. Sand/Sediment 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 Division 22 Section "Identification for Plumbing Piping and Equipment."

3.6 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.

3.7 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.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain oil and sand interceptors.

END OF SECTION 221319

SECTION 221343 - PACKAGED DUPLEX GRINDER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The contractor shall provide labor, materials, equipment and incidentals required to provide one 2HP Grinder Pump Package, consisting of two (2) centrifugal grinder pumps as specified herein. The pump models shall be LSG Series three phase grinder pumps as per Omnivore D3684LSGX203-S-IP as manufactured by Liberty Pumps or approved similar.

B. 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 wet-well, packaged pumping stations with submersible grinder sewage pumps.

1.3 PERFORMANCE REQUIREMENTS

A. Pressure Rating of Sewage Pumps and Discharge Piping Components: At least equal to sewage pump discharge pressure, but not less than 125 psig.

B. Pressure Rating of Other Piping Components: At least equal to system operating pressure.

1.4 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Show fabrication and installation details for each packaged sewage pumping station. Detail equipment assemblies and indicate dimensions; shipping, installed, and operating weights; loads; required clearances; method of field assembly; components; electrical characteristics; and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of sewage pump, signed by product manufacturer.

B. Manufacturer Seismic Qualification Certification: Submit certification that packaged sewage pumping station, accessories, and components will withstand seismic forces defined in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Qualification Data: For Installer.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For equipment to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Comply with HI 1.1-1.2, "Centrifugal Pumps for Nomenclature and Definitions"; HI 1.3, "Centrifugal Pumps for Design and Application"; and HI 1.4, "Centrifugal Pumps for Installation, Operation and Maintenance," for sewage pumps.

C. Comply with UL 778, "Motor-Operated Water Pumps," for sewage pumps.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Sewer Service: Do not interrupt sanitary sewer service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sanitary sewer service according to requirements indicated:

1. Notify Engineer and Owner no fewer than two days in advance of proposed interruption of sanitary sewer service.
2. Do not proceed with interruption of sanitary sewer service without Engineer or Owner's written permission.

1.9 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged sewage pumping stations that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including shell.
    b. Faulty operation of sewage pumps, controls, or accessories.
    c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Period for Shell: 3 years from date of Substantial Completion.
3. Warranty Period for Sewage Pumps and Controls: 3 years from date of Substantial Completion.
4. Warranty Period for Accessories: 3 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 WET-WELL, PACKAGED SEWAGE GRINDER PUMPING STATIONS

A. Wet-Well, Packaged Sewage Pumping Station with Submersible Grinder Sewage Pumps:

1. Description: Factory fabricated, assembled, and tested with wet well for sewage pumps and collection of sanitary sewage and with dry equipment chamber for controls and accessories.

    a. Orientation: Shell underground with dry equipment chamber underground with top flush with grade.
    b. Shell: Factory fabricated from fiberglass.

    c. Sewage Pumps: Two submersible grinder-type sewage pumps, with guide rail, quick-disconnect system, controls, and piping. Include stainless-steel grinder impeller and hermetically sealed motor with moisture-sensing probe, mechanical seals, and waterproof power cable.

2. Capacities and Characteristics:

    a. Diameter or Dimensions of Shell: 36 inches.
    b. Height of Shell Base Section: 72 inches.
    c. Pumping Station, Inlet Pipe Size: 4-inches with flange gasket and pipe seal.
    d. Pumping Station, Discharge Pipe Size: 2” Schedule 80 PVC
    e. Sewage Pumps: Two required.
    f. Each Sump Pump:

        1) Capacity: 36 gpm.
        2) Total Dynamic Head: 55 feet.
        3) Speed: 3450 rpm
        4) Impeller: Grinder type.
        5) Inlet Size: 4” With flange gasket and pipe seal.
        6) Discharge Size: 2” Schedule 40 PVC.
        7) Motor Size: 2 hp.
        8) Electrical Characteristics:

            a) Volts: 208 V.
            b) Phases: Three
            c) Hertz: 60.

    g. Characteristics:

        1) Full-Load Amperes: 10.6.
        2) Minimum Circuit Ampacity: 30 Amp
        3) Maximum Overcurrent Protection: 30 Amp

2.2 CONTROLS

A. Control Sequence of Operation: Cycle each sewage pump on and off automatically to maintain wet-well sewage level. Automatic control operates both pumps in parallel if wet-well level rises above starting point of low-level pump, until shutoff level is

reached. Automatic alternator, with manual disconnect switch, changes sequence of lead-lag sewage pumps at completion of each pumping cycle.

B. Transducer System: Senses variations of sewage level in wet well. Include high and low adjustments capable of operating on 6-inch minimum differential of liquid level.

C. Motor Controllers: Magnetic, full voltage, non-reversing. Include undervoltage release, thermal-overload heaters in each phase, manual reset buttons, and hand-automatic selector switches. Include circuit breakers to provide branch-circuit protection for each controller.

D. 120-V accessory controls with 15-A, single-phase circuit breakers or fuses for each item.

E. Control Panel: NEMA 4X weatherproof enclosure for indoor/outdoor mounting with audible 80 DBI and visual high-water alarm, complying with UL 508A with separate compartments and covers for controllers, circuit breakers, transformers, alternators, and single-phase controls. Include 20-A duplex receptacle in NEMA WD 1, Configuration 5-20R mounted on exterior of control panel.

1. Mounting: At Grinder Pump

2. Enclosure: NEMA 4X

F. Install labels on panel face to identify switches and controls.

G. Wiring: copper wiring.

H. The electrical system has a backup emergency generator. The station must restart upon transfer of power.

2.3 ACCESSORIES

A. Ventilation system is designed to be vented from the 4-inch diameter inlet pipe through a Office Building Vent Stack.

B. High-Water Audio Alarm: Horn for audio indication of station high-water level, energized by °Remote Alarm Circuit: Include contacts for connection to remote alarm panel.

2.4 MOTORS

A. Motors shall be oil filled and class B insulated NEMA B design, rated for continuous duty.

2.5 MISCELLANEOUS MATERIALS

A. Grout: ASTM C 1107, Grade B, non-shrink cement grout.

1. Design Mix: 4000-psi 28-day compressive strength.

B. Concrete: Concrete is specified in Section 033000 "Cast-in-Place Concrete."

2.6 PACKAGED SEWAGE PUMPING STATION FABRICATION

A. Fabricate shell from fiberglass with structural-steel reinforcement.

1. Attach structural-steel reinforcement to top and bottom heads.
2. Fabricate shell with continuous joints to make watertight and gastight construction.
3. Attach air vent to pump chamber.

B. Entrance tube may be furnished separately for field installation.

C. Entrance Cover: Waterproof and corrosion resistant, with lock. Include way to open cover from inside tube if cover is locked.

D. Air Vent: Duct fabricated from corrosion-resistant material, extended to above grade, outlet turned down, and with insect screen in outlet.

E. Valves:

1. Sewage Pump Piping: Include gate valve on each pump inlet and gate and check valves on each discharge pipe.

F. Wiring: Tin-coated copper.

2.7 SOURCE QUALITY CONTROL

A. Test and inspect sewage pumps according to HI 1.6, "Centrifugal Pump Tests." Include test recordings that substantiate correct performance of pumps at design head, capacity, speed, and horsepower.

B. Test accessories and controls through complete cycle. Include test recordings that substantiate correct performance.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of sewerage piping systems to verify actual locations of piping connections before packaged sewage pumping station installation.

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

3.2 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.3 INSTALLATION

A. Install packaged sewage pumping station components where indicated, according to specific equipment and piping arrangement indicated.

3.4 CONNECTIONS

A. Sanitary sewer piping installation requirements are specified in Section 02627 "HDPE Pipe and Fittings." Drawings indicate general arrangement of piping.

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.5 IDENTIFICATION

A. Install identifying labels permanently attached to equipment.

B. Install operating instruction signs permanently attached to equipment or on pumping station wall near control equipment.

3.6 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing packaged sewage pumping stations and after electrical circuitry has been energized, test for compliance with requirements. Furnish water required for pump tests.

2. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace packaged sewage pumping stations that do not pass tests and inspections and retest as specified above.

3.7 STARTUP SERVICE

1. Complete installation and startup check according to manufacturer's written instructions.
2. Adjust pump, accessory, and control settings, and safety and alarm devices.

END OF SECTION 221343

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes plumbing fixtures and related components.

B. Related Sections include the following:

1. Provide plumbing fixtures in accordance with the fixtures schedules provided on the drawings.

1.3 DEFINITIONS

A. 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 and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

1.4 SUBMITTALS

A. 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 scheduled.

B. Maintenance Data: For plumbing fixtures to include in maintenance manuals specified in Division 1.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components in the same category through one source from a single manufacturer.

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"[; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act";] about plumbing fixtures for people with disabilities.

C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

F. Comply with the following applicable standards and other requirements specified for faucets:

1. Faucets: ASME A112.18.1M.
2. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
3. Supply and Drain Fittings: ASME A112.18.1M.
4. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
5. Faucets: ASME A112.18.1M.
6. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
7. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

G. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Floor Drains: ASME A112.21.1M.
2. Grab Bars: ASTM F 446.
3. Hose-Coupling Threads: ASME B1.20.7.
4. Hot-Water Dispensers: ASSE 1023 and UL 499.
5. Off-Floor Fixture Supports: ASME A112.6.1M.
6. Pipe Threads: ASME B1.20.1.
7. Plastic Toilet Seats: ANSI Z124.5.
8. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 COORDINATION

A. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

1.7 EXTRA MATERIALS

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

1. Supply, Flow-Control Fittings: Equal to 5 percent of amount of each type and size installed.
2. Flushometer Valve, Repair Kits: Equal to 5 percent of amount of each type installed, but not less than 10 of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified in other Part 2 articles.

B. Provide plumbing fixtures in accordance with the plumbing fixture schedule included with the contract drawings. Provide all accessories (carriers, mounting hardware, seats, etc) as required to install and operate plumbing fixtures even if not specifically shown on the drawings or required by the specifications.

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 are 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. Install counter-mounting fixtures in and attached to casework.

C. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.

D. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball, gate, or globe valve if stops are not specified with fixture.

E. Install trap and tubular waste piping on drain outlet of each fixture an connect to drainage system.

F. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

G. Install toilet seats on water closets.

H. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

I. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings.

J. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Plumbing Specification Sections. 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. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.

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 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Replace washers and seals of leaking and dripping faucets and stops.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.
3. Clean fixtures to a reasonable degree of shine. No visable grease or other marks from construction should be apparent.

3.7 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 224000

SECTION 230500 - COMMON WORK REQUIREMENTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. HVAC demolition.
8. Equipment installation requirements common to equipment sections.
9. Concrete bases.
10. Supports and anchorages.

1.2 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.

1.3 SUBMITTALS

A. Welding certificates.

1.4 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.

D. Sheet metal construction documents are diagrammatic. Equivalent sizes can be substituted when construction begins as long as aspect ratios are no greater then 3:1 for rectangular, or round instead of square substitutions provide the same static pressure per 100ft. Duct runs are to be coordinated in the field with the other trades. Duct materials can not be changed without the permission of the engineer. Flex ducts are to be no longer than eight feet and must be supported from overhead.

PART 2 - PRODUCTS

2.1 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.

2.2 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, 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 or BAg1, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12.

G. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.
2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.3 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Stainless steel. Include two for each sealing element.

D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

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. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

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 (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 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.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using 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.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) 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 (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve.

Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. 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.

3.3 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.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

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

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install 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.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 03 Sections.

3.7 PAINTING AND FINISHING

A. Apply semi-gloss, acrylic-enamel finish to exposed piping according to the following:

1. Interior, Ferrous Piping and Ferrous Supports: Finish coat over enamel undercoat and primer.
2. Interior and Exterior, Galvanized-Steel Piping: Two finish coats over galvanized metal primer.

3. Exterior, Ferrous Piping and Ferrous Supports: Two finish coats over rust-inhibitive metal primer.
4. Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved. Repair cut surfaces to match adjacent surfaces.

3.9 CONTROLS COORDINATION

A. For electrical interface of controls the following is the method to be coordinated with division 23. Division 23 is to provide junction box with cover, conduit, and power to JB. The cover is to be labeled with its respective panel number and breaker number. Control contractor will provide the control transformers and all wiring there after to devices and is to coordinate with Division 16 in the field.

3.10 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.

3.11 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.12 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.

END OF SECTION 230500

SECTION 230513 - 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 230513

SECTION 230519 - METERS AND GAUGES 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. Bimetallic-actuated thermometers.
2. Filled-system thermometers.
3. Liquid-in-glass thermometers.
4. Light-activated thermometers.
5. Thermowells.
6. Dial-type pressure gauges.
7. Gauge attachments.
8. Test plugs.
9. Test-plug kits.
10. Sight flow indicators.
11. Orifice flowmeters.
12. Pitot-tube flowmeters.
13. Turbine flowmeters.
14. Venturi flowmeters.
15. Vortex-shedding flowmeters.

B. Related Sections:

1. Division 23 Section "Facility Natural-Gas Piping" for gas meters.

1.3 SUBMITTALS

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

B. Wiring Diagrams: For power, signal, and control wiring.

C. Product Certificates: For each type of meter and gauge, from manufacturer.

D. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

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

1. Ashcroft Inc.
2. Ernst Flow Industries.
3. Marsh Bellofram.
4. Miljoco Corporation.
5. Nanmac Corporation.
6. Noshok.
7. Palmer Wahl Instrumentation Group.
8. REOTEMP Instrument Corporation.
9. Tel-Tru Manufacturing Company.
10. Trerice, H. O. Co.
11. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
12. Weiss Instruments, Inc.
13. WIKA Instrument Corporation - USA.
14. Winters Instruments - U.S.

B. Standard: ASME B40.200.

C. Case: Liquid-filled and sealed type(s); stainless steel with 5-inch nominal diameter.

D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.

E. Connector Type(s): Union joint, adjustable angle with unified-inch screw threads.

F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

H. Window: Plain glass.

I. Ring: Stainless steel.

J. Element: Bimetal coil.

K. Pointer: Dark-colored metal.

L. Accuracy: Plus or minus 1 percent of scale range.

2.2 FILLED-SYSTEM THERMOMETERS

A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:

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

    a. Ashcroft Inc.
    b. Marsh Bellofram.
    c. Miljoco Corporation.
    d. Palmer Wahl Instrumentation Group.
    e. REOTEMP Instrument Corporation.
    f. Trerice, H. O. Co.
    g. Weiss Instruments, Inc.

2. Standard: ASME B40.200.
3. Case: Sealed type, cast aluminum or drawn steel; 5-inch nominal diameter.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Pointer: Dark-colored metal.
8. Window: Glass.
9. Ring: Stainless steel.
10. Connector Type(s): Union joint, [adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

12. Accuracy: Plus or minus 1 percent of scale range.

B. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers:

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

    a. AMETEK, Inc.; U.S. Gauge.
    b. Ashcroft Inc.
    c. Marsh Bellofram.
    d. Miljoco Corporation.
    e. Palmer Wahl Instrumentation Group.
    f. REOTEMP Instrument Corporation.
    g. Trerice, H. O. Co.
    h. Weiss Instruments, Inc.
    i. WIKA Instrument Corporation - USA.

2. Standard: ASME B40.200.

3. Case: Sealed type, cast aluminum or drawn steel; 4-1/2-inch nominal diameter with [back] [front] flange and holes for panel mounting.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Pointer: Dark-colored metal.
8. Window: Glass].
9. Ring: Stainless steel.
10. Connector Type(s): Union joint, back or bottom; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

12. Accuracy: Plus or minus 1 percent of scale range.

2.3 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

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

    a. Trerice, H. O. Co.

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 6-inch nominal size.
4. Case Form: Straight unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass or plastic.
8. Stem: Aluminum or brass and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

9. Connector: 3/4 inch, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

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

a. Flo Fab Inc.
b. Miljoco Corporation.
c. Palmer Wahl Instrumentation Group.
d. Tel-Tru Manufacturing Company.
e. Trerice, H. O. Co.
f. Weiss Instruments, Inc.
g. Winters Instruments - U.S.

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle, Back angle or Straight unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass.
8. Stem: Aluminum and of length to suit installation.

a. Design for Air-Duct Installation: With ventilated shroud.
b. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.4 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.5 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or] CUNI.
4. Material for Use with Steel Piping: CRES or CSA.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.

11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.6 PRESSURE GAUGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges:

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

    a. AMETEK, Inc.; U.S. Gauge.
    b. Ashcroft Inc.
    c. Ernst Flow Industries.
    d. Flo Fab Inc.
    e. Marsh Bellofram.
    f. Miljoco Corporation.
    g. Noshok.
    h. Palmer Wahl Instrumentation Group.
    i. REOTEMP Instrument Corporation.
    j. Tel-Tru Manufacturing Company.
    k. Trerice, H. O. Co.
    l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
    m. Weiss Instruments, Inc.
    n. WIKA Instrument Corporation - USA.
    o. Winters Instruments - U.S.

2. Standard: ASME B40.100.
3. Case: Liquid-filled; cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.

5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Brass.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Remote-Mounted, Metal-Case, Dial-Type Pressure Gauges:

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

a. AMETEK, Inc.; U.S. Gauge.
b. Ashcroft Inc.
c. Ernst Flow Industries.
d. Flo Fab Inc.
e. Marsh Bellofram.
f. Miljoco Corporation.
g. Noshok.
h. Palmer Wahl Instrumentation Group.
i. REOTEMP Instrument Corporation.
j. Tel-Tru Manufacturing Company.
k. Trerice, H. O. Co.
l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
m. Weiss Instruments, Inc.
n. WIKA Instrument Corporation - USA.
o. Winters Instruments - U.S.

2. Standard: ASME B40.100.
3. Case: Liquid-filled type; cast aluminum; 4-1/2-inch nominal diameter with back flange and holes for panel mounting.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.

5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.7 GAUGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and piston porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of brass stainless-steel pipe with NPS 1/4 pipe threads.

C. Valves: Brass ballwith NPS 1/4, ASME B1.20.1 pipe threads.

2.8 TEST PLUGS

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

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.9 TEST-PLUG KITS

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

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gauge and adapter, and carrying case. Thermometer sensing elements, pressure gauge, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.

D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.

E. Pressure Gauge: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.

F. Carrying Case: Metal or plastic, with formed instrument padding.

2.10 SIGHT FLOW INDICATORS

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

1. Archon Industries, Inc.
2. Dwyer Instruments, Inc.
3. Emerson Process Management; Brooks Instrument.
4. Ernst Co., John C., Inc.
5. Ernst Flow Industries.
6. KOBOLD Instruments, Inc. - USA; KOBOLD Messring GmbH.
7. OPW Engineered Systems; a Dover company.
8. Penberthy; A Brand of Tyco Valves & Controls - Prophetstown.

B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

D. Minimum Pressure Rating: 150 psig.

E. Minimum Temperature Rating: 200 deg F.

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged.

2.11 FLOWMETERS

A. Orifice Flowmeters:

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

a. ABB; Instrumentation and Analytical.
b. Bell & Gossett; ITT Industries.
c. Meriam Process Technologies.
d. Preso Meters; a division of Racine Federated Inc.
e. S. A. Armstrong Limited; Armstrong Pumps Inc.

2. Description: Flowmeter with sensor, hoses or tubing, fittings, valves, indicator, and conversion chart.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.

4. Sensor: Wafer-orifice-type, calibrated, flow-measuring element; for installation between pipe flanges.

    a. Design: Differential-pressure-type measurement for water.
    b. Construction: Cast-iron body, brass valves with integral check valves and caps, and calibrated nameplate.
    c. Minimum Pressure Rating: 300 psig.
    d. Minimum Temperature Rating: 250 deg F.

5. Permanent Indicators: Meter suitable for wall or bracket mounting, calibrated for connected sensor and having 6-inch- diameter, or equivalent, dial with fittings and copper tubing for connecting to sensor.

    a. Scale: Gallons per minute.
    b. Accuracy: Plus or minus 1 percent between 20 and 80 percent of scale range.

6. Portable Indicators: Hand-held, differential-pressure type, calibrated for connected sensor and having two 12-foot hoses, with carrying case.

    a. Scale: Gallons per minute.
    b. Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range.

7. Display: Shows rate of flow, with register to indicate total volume in gallons.
8. Conversion Chart: Flow rate data compatible with sensor and indicator.
9. Operating Instructions: Include complete instructions with each flowmeter.

B. Pitot-Tube Flowmeters:

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

    a. ABB; Instrumentation and Analytical.
    b. Emerson Process Management; Rosemount.
    c. Meriam Process Technologies.
    d. Preso Meters; a division of Racine Federated Inc.
    e. TACO Incorporated.
    f. Veris Industries, Inc.

2. Description: Flowmeter with sensor and indicator.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
4. Sensor: Insertion type; for inserting probe into piping and measuring flow directly in gallons per minute.

    a. Design: Differential-pressure-type measurement for water.

b. Construction: Stainless-steel probe of length to span inside of pipe, with integral transmitter and direct-reading scale.
c. Minimum Pressure Rating: 150 psig.
d. Minimum Temperature Rating: 250 deg F.

5. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
6. Integral Transformer: For low-voltage power connection.
7. Accuracy: Plus or minus 3 percent.
8. Display: Shows rate of flow, with register to indicate total volume in gallons.
9. Operating Instructions: Include complete instructions with each flowmeter.

C. Turbine Flowmeters:

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

a. ABB; Instrumentation and Analytical.
b. Data Industrial Corp.
c. EMCO Flow Systems; a division of Spirax Sarco, Inc.
d. ERDCO Engineering Corp.
e. Hoffer Flow Controls, Inc.
f. Liquid Controls; a unit of IDEX Corporation.
g. McCrometer, Inc.
h. Midwest Instruments & Controls Corp.
i. ONICON Incorporated.
j. SeaMetrics, Inc.
k. Sponsler, Inc.; a unit of IDEX Corporation.

2. Description: Flowmeter with sensor and indicator.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
4. Sensor: Impeller turbine; for inserting into pipe fitting or for installing in piping and measuring flow directly in gallons per minute.

a. Design: Device or pipe fitting with inline turbine and integral direct-reading scale for water.
b. Construction: Bronze or stainless-steel body, with plastic turbine or impeller.
c. Minimum Pressure Rating: 150 psig.
d. Minimum Temperature Rating: 180 deg F.

5. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
6. Accuracy: Plus or minus 1-1/2 percent.
7. Display: Shows rate of flow, with register to indicate total volume in gallons.
8. Operating Instructions: Include complete instructions with each flowmeter.

D. Venturi Flowmeters:

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

    a. ABB; Instrumentation and Analytical.
    b. Gerand Engineering Co.
    c. Hyspan Precision Products, Inc.
    d. Preso Meters; a division of Racine Federated Inc.
    e. S. A. Armstrong Limited; Armstrong Pumps Inc.
    f. Victaulic Company.

2. Description: Flowmeter with calibrated flow-measuring element, hoses or tubing, fittings, valves, indicator, and conversion chart.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
4. Sensor: Venturi-type, calibrated, flow-measuring element; for installation in piping.

    a. Design: Differential-pressure-type measurement for water.
    b. Construction: Bronze, brass, or factory-primed steel, with brass fittings and attached tag with flow conversion data.
    c. Minimum Pressure Rating: 250 psig.
    d. Minimum Temperature Rating: 250 deg F.
    e. End Connections for NPS 2 and Smaller: Threaded.
    f. End Connections for NPS 2-1/2 and Larger: Flanged or welded.
    g. Flow Range: Flow-measuring element and flowmeter shall cover operating range of equipment or system served.

5. Permanent Indicators: Meter suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch- diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.

    a. Scale: Gallons per minute.
    b. Accuracy: Plus or minus 1 percent between 20 and 80 percent of scale range.

6. Portable Indicators: Hand-held, differential-pressure type, calibrated for connected flowmeter element and having two 12-foot hoses, with carrying case.

    a. Scale: Gallons per minute.
    b. Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range.

7. Display: Shows rate of flow, with register to indicate total volume in gallons.
8. Conversion Chart: Flow rate data compatible with sensor.
9. Operating Instructions: Include complete instructions with each flowmeter.

E. Vortex-Shedding Flowmeters:

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

    a. ABB; Instrumentation and Analytical.
    b. Eastech Flow Controls.
    c. EMCO Flow Systems; a division of Spirax Sarco, Inc.
    d. Emerson Process Management; Rosemount.
    e. Endress+Hauser.
    f. ISTEC Corporation.

2. Description: Flowmeter with sensor and indicator.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
4. Sensor: Inline type; for installing between pipe flanges and measuring flow directly in gallons per minute.

    a. Design: Flow obstruction device, vortex-measurement type for liquids.
    b. Construction: Stainless-steel body, with integral transmitter and direct-reading scale.
    c. Minimum Pressure Rating: 1000 psig.
    d. Minimum Temperature Rating: 500 deg F.
    e. Integral Transformer: For low-voltage power operation.

5. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
6. Accuracy: Plus or minus 0.25 percent for liquids and 0.75 percent for gases.
7. Display: Shows rate of flow, with register to indicate total volume in gallons.
8. Operating Instructions: Include complete instructions with each flowmeter.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe 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 remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

H. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.

I. Install remote-mounted pressure gauges on panel.

J. Install valve and snubber in piping for each pressure gauge for fluids (except steam).

K. Install valve and syphon fitting in piping for each pressure gauge for steam.

L. Install test plugs in piping tees.

M. Install flow indicators in piping systems in accessible positions for easy viewing.

N. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

O. Install flowmeter elements in accessible positions in piping systems.

P. Install wafer-orifice flowmeter elements between pipe flanges.

Q. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.

R. Install permanent indicators on walls or brackets in accessible and readable positions.

S. Install connection fittings in accessible locations for attachment to portable indicators.

T. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.

U. Install thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic boiler.
3. Two inlets and two outlets of each chiller.
4. Inlet and outlet of each hydronic coil in air-handling units.
5. Two inlets and two outlets of each hydronic heat exchanger.
6. Inlet and outlet of each thermal-storage tank.
7. Outside-, return-, supply-, and mixed-air ducts.

V. Install pressure gauges in the following locations:

1. Discharge of each pressure-reducing valve.
2. Inlet and outlet of each chiller chilled-water and condenser-water connection.
3. Suction and discharge of each pump.

3.2 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow service and maintenance of meters, gauges, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Connect thermal-energy meter transmitters to meters.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gauges to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each hydronic zone shall be the following:

1. Direct-mounted, metal-case, vapor-actuated type.
2. Test plug with EPDM self-sealing rubber inserts.

B. Thermometers at inlet and outlet of each hydronic boiler shall be the following:

1. Liquid-filled, bimetallic-actuated type.

C. Thermometers at inlets and outlets of each chiller shall be the following:

1. Liquid-filled, bimetallic-actuated type.

D. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be the following:

1. Liquid-filled, bimetallic-actuated type.

E. Thermometers at inlets and outlets of each hydronic heat exchanger shall be the following:

1. Liquid-filled, bimetallic-actuated type.

F. Thermometers at inlet and outlet of each thermal-storage tank shall be the following:

1. Liquid-filled, bimetallic-actuated type.

G. Thermometers at outside-, return-, supply-, and mixed-air ducts shall be[one of] the following:

1. Sealed, bimetallic-actuated type.

H. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 deg F.

B. Scale Range for Condenser-Water Piping: 0 to 150 deg F.

C. Scale Range for Heating, Hot-Water Piping: 0 to 250 deg F.

D. Scale Range for Air Ducts: [Minus 40 to plus 110 deg F] [Minus 40 to plus 110 deg F and minus 40 to plus 45 deg C].

E. Scale Range for Air Ducts: 0 to 100 deg F.

3.6 PRESSURE-GAUGE SCHEDULE

A. Pressure gauges at discharge of each pressure-reducing valve shall be the following:

1. Liquid-filled or Sealed direct-mounted, metal case.

B. Pressure gauges at inlet and outlet of each chiller chilled-water and condenser-water connection shall be one of the following:

1. Liquid-filled direct mounted, metal case.

C. Pressure gauges at suction and discharge of each pump shall be the following:

1. Liquid-filled, direct-mounted, metal case.

3.7 PRESSURE-GAUGE SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 psi.

B. Scale Range for Condenser-Water Piping: 0 to 100 psi.

C. Scale Range for Heating, Hot-Water Piping: 0 to 100 psi.

3.8 FLOWMETER SCHEDULE

A. Flowmeters for Chilled-Water Piping: Venturi, rtex-shedding type.

B. Flowmeters for Condenser-Water Piping: Venturi, rtex-shedding type.

C. Flowmeters for Heating, Hot-Water Piping: Venturi, rtex-shedding type.

END OF SECTION 230519

SECTION 230523 - 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. Brass ball valves.
2. Iron, single-flange butterfly valves.
3. High-performance butterfly valves.
4. Bronze lift check valves.
5. Bronze swing check valves.
6. Iron swing check valves.
7. Bronze gate valves.
8. Iron gate valves.
9. Chainwheels.

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 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 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. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.

2. 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.

2.2 BRASS BALL VALVES

A. One-Piece, Full-Port, Brass Ball Valves with Brass Trim:

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

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Div.
d. Grinnell Corporation.
e. Jamesbury, Inc.
f. NIBCO INC.
g. Watts Industries, Inc.; Water Products Div.
h. Kitz Corporation.

2. Description:

a. Standard: MSS SP-110.

b. CWP Rating: 400 psig.
c. Body Design: One piece.
d. Body Material: Forged brass.
e. Ends: Threaded.
f. Seats: PTFE or TFE.
g. Stem: Brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

B. Three-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

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

a. Jomar International, LTD.
b. Kitz Corporation.
c. Marwin Valve; a division of Richards Industries.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
e. Conbraco Industries, Inc.; Apollo Div.
f. Grinnell Corporation.
g. Jamesbury, Inc.
h. NIBCO INC.
i. PBM, Inc.

2. Controls Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Three piece.
e. Body Material: Forged brass.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

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

a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. American Valve, Inc.

c. Conbraco Industries, Inc.; Apollo Valves.
d. Cooper Cameron Valves; a division of Cooper Cameron Corp.
e. Crane Co.; Crane Valve Group; Jenkins Valves.
f. Crane Co.; Crane Valve Group; Stockham Division.
g. DeZurik Water Controls.
h. Dover Corp.; Dover Resources Company; Norriseal Div.
i. Flo Fab Inc.
j. Grinnell Corporation
k. Hammond Valve.
l. Kitz Corporation.
m. Legend Valve.
n. Milwaukee Valve Company.
o. Mueller Steam Specialty; a division of SPX Corporation.
p. NIBCO INC.
q. Norriseal; a Dover Corporation company.
r. Red-White Valve Corporation.
s. Spence Strainers International; a division of CIRCOR International.
t. Sure Flow Equipment Inc.
u. Tyco International, Ltd.; Tyco Valves & Controls.
v. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

2.4 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 150, Single-Flange, High-Performance Butterfly Valves:

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

a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. Bray Controls; a division of Bray International.
c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
d. Crane Co.; Crane Valve Group; Flowseal.
e. Crane Co.; Crane Valve Group; Stockham Division.
f. DeZurik Water Controls.
g. Hammond Valve.

h. Jamesbury; a subsidiary of Metso Automation.
i. Milwaukee Valve Company.
j. NIBCO INC.
k. Process Development & Control, Inc.
l. Tyco Valves & Controls; a unit of Tyco Flow Control.
m. Xomox Corporation.

2. Description:

a. Standard: MSS SP-68.
b. CWP Rating: 285 psig at 100 deg F.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: Carbon steel, cast iron, ductile iron, or stainless steel.
e. Seat: Reinforced PTFE or metal.
f. Stem: Stainless steel; offset from seat plane.
g. Disc: Carbon steel.
h. Service: Bidirectional.

2.5 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

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

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.6 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:

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

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Grinnell Corporation.
f. Kitz Corporation.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Red-White Valve Corporation.
j. Watts Industries, Inc.; Water Products Div.
k. Zy-Tech Global Industries, Inc.

2. Description:

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

2.7 IRON SWING CHECK VALVES

A. Class 250, Iron Swing Check Valves with Metal Seats:

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

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Cincinnati Valve Company
e. Flomatic Valves
f. Grinnell Corporation
g. Hammond Valve.
h. Milwaukee Valve Company.
i. NIBCO INC.
j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-71, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
c. NPS 14 to NPS 24, CWP Rating: 300 psig.
d. Body Design: Clear or full waterway.
e. Body Material: ASTM A 126, gray iron with bolted bonnet.
f. Ends: Flanged.

g. Trim: Bronze.
h. Gasket: Asbestos free.

2.8 BRONZE GATE VALVES

A. Class 150, NRS Bronze Gate Valves:

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

a. Hammond Valve.
b. Kitz Corporation.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Powell Valves.
f. Red-White Valve Corporation.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
h. American Valve, Inc.
i. Grinnell Corporation.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron bronze, or aluminum.

2.9 IRON GATE VALVES

A. Class 250, NRS, Iron Gate Valves:

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

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. NIBCO INC.
d. Cincinnati Valve Company
e. Grinnell Corporation

2. Description:

a. Standard: MSS SP-70, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
c. NPS 14 to NPS 24, CWP Rating: 300 psig.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Disc: Solid wedge.
h. Packing and Gasket: Asbestos free.

B. Class 250, OS&Y, Iron Gate Valves:

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

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Powell Valves.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
h. Grinnell Corporation

2. Description:

a. Standard: MSS SP-70, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
c. NPS 14 to NPS 24, CWP Rating: 300 psig.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Disc: Solid wedge.
h. Packing and Gasket: Asbestos free.

2.10 CHAINWHEELS

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

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.
3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.

2. Attachment: For connection to butterfly valve stems.

3. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve. Include zinc coating.

4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

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 chainwheels on operators for butterfly and gate valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

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

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly or gate valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling Service except Steam: ball or butterfly valves.
4. Throttling Service, Steam: butterfly valves.
5. Pump-Discharge Check Valves:

    a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
    b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Brass and Bronze Valves: May be provided with solder-joint ends instead of threaded ends.

2. Ball Valves: One or Three piece, full port, brass with stainless-steel trim.
3. Bronze Swing Check Valves: Class 150, bronze disc.
4. Bronze Gate Valves: Class 150, [NRS, bronze.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.

2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, stainless-steel disc.
3. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24: 150 CWP, EPDM seat, stainless-steel disc.
4. High-Performance Butterfly Valves: Class 150, single flange.

5. Iron Swing Check Valves: Class 250, metal seats.

6. Iron Gate Valves: Class 250, NRS or OS&Y.

3.6 CONDENSER-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Brass and Bronze Valves: May be provided with solder-joint ends instead of threaded ends.

2. Ball Valves: One or Three piece, full port, brass with stainless-steel trim.
3. Bronze Swing Check Valves: Class 150, bronze disc.
4. Bronze Gate Valves: Class 150, NRS.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.

2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, stainless-steel disc.
3. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24: 150 CWP, EPDM seat, stainless-steel disc.
4. High-Performance Butterfly Valves: Class 150, single flange.

5. Iron Swing Check Valves: Class 250, metal seats.

6. Iron Gate Valves: Class 250, NRS or OS&Y.

3.7 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.

2. Ball Valves: One or Three piece, full port, brass with stainless-steel trim.
3. Bronze Swing Check Valves: Class 150, bronze disc.
4. Bronze Gate Valves: Class 150, NRS.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.

2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, stainless-steel disc.
3. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24: 150 CWP, EPDM seat, stainless-steel disc.
4. High-Performance Butterfly Valves: Class 150, single flange.

5. Iron Swing Check Valves: Class 250, metal seats.
6. Iron Gate Valves: Class 250, NRS or OS&Y.

3.8 LOW-PRESSURE STEAM VALVE SCHEDULE (15 PSIG OR LESS)

A. Pipe NPS 2 and Smaller:

1. Ball Valves: One or Three piece, full port, brass with stainless-steel trim.

2. Bronze Swing Check Valves: Class 150, bronze disc.
3. Bronze Gate Valves: Class 150, NRS.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.

2. High-Performance Butterfly Valves: Class 150, single flange.

3. Iron Swing Check Valves: Class 250, metal seats.
4. Iron Gate Valves: Class 250, NRS or OS&Y.

3.9 STEAM-CONDENSATE VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Ball Valves: One or Three] piece, full port, brass with stainless-steel trim.

2. Bronze Swing Check Valves: Class 150, bronze disc.
3. Bronze Gate Valves: Class 150, NRS.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.

2. High-Performance Butterfly Valves: Class 150, single flange.

3. Iron Swing Check Valves: Class 250, metal seats.
4. Iron Gate Valves: Class 250, NRS or OS&Y.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal-hanger shield inserts.
7. Fastener systems.
8. Pipe stands.
9. Equipment supports.

B. Related Sections:

1. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
2. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, 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: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.
5. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

D. 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 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.2 TRAPEZE PIPE HANGERS

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

2.3 FIBERGLASS PIPE HANGERS

A. Clevis-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 1, steel pipe hanger except hanger is made of fiberglass or fiberglass-reinforced resin.

2. Hanger Rods: Continuous-thread rod, washer, and nuts made of stainless steel.

B. Strap-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 9 or Type 10, steel pipe hanger except hanger is made of fiberglass-reinforced resin.

2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

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

    a. Allied Tube & Conduit.
    b. Cooper B-Line, Inc.
    c. Flex-Strut Inc.
    d. GS Metals Corp.
    e. Thomas & Betts Corporation.
    f. Unistrut Corporation; Tyco International, Ltd.
    g. Wesanco, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

7. Metallic Coating: Electroplated zinc.
8. Paint Coating: Epoxy.
9. Plastic Coating: Epoxy.

2.5 FIBERGLASS STRUT SYSTEMS

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

1. Allied Tube & Conduit.
2. Champion Fiberglass, Inc.
3. Cooper B-Line, Inc.
4. SEASAFE, INC.; a Gibraltar Industries Company.

B. Description: Shop- or field-fabricated pipe-support assembly similar to MFMA-4 for supporting multiple parallel pipes.

1. Channels: Continuous slotted fiberglass channel with inturned lips.
2. Channel Nuts: Fiberglass nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.6 THERMAL-HANGER SHIELD INSERTS

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

1. Carpenter & Paterson, Inc.

2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.7 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.8 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.9 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.10 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. 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. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.

F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

G. 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.

H. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.

I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

K. 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.

L. Install lateral bracing with pipe hangers and supports to prevent swaying.

M. 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.

N. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

P. 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 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.

e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 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 bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. 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 metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F,pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.

21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): 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.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

a. Horizontal (MSS Type 54): Mounted horizontally.
b. Vertical (MSS Type 55): Mounted vertically.
c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230548 - VIBRATION AND SEISMIC 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 1 specification sections, apply to this section.

1.2 SUMMARY

A. Provide seismic restraints and supports for all mechanical equipment, piping, plumbing, and fire protection in accordance with the International Building Code, NFPA-13, SMACNA and standard practice.

B. Provide vibration isolators on all piping, ductwork, and equipment.

1.3 SUBMITTALS:

A. Product Data: Include load deflection curves for each vibration isolation device.

B. Shop Drawings: Include the following:

1. Design Calculations: Calculate requirements for selecting vibration isolators and for vibration isolation bases. All calculations shall be signed and sealed by a professional Engineer licensed in the State of New Jersey.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 VIBRATION ISOLATORS

A. Manufacturers:
1. Mason Industries, Inc.
2. Amber/Booth Company, Inc.
3. Kinetics Noise Control, Inc.

B. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 100 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

C. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.

1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
2. Base: Factory drilled for bolting to structure.
3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel before contacting a resilient collar.

D. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

E. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5, with a flat washer face.

2.3 VIBRATION ISOLATION EQUIPMENT BASES

A. Manufacturers:

1. Amber/Booth Company, Inc.
2. California Dynamics Corp.

3. Isolation Technology, Inc.
4. Kinetics Noise Control, Inc.
5. Mason Industries, Inc.
6. Vibration Eliminator Co., Inc.
7. Vibration Isolation Co., Inc.
8. Vibration Mountings & Controls/Korfund.

B. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for field-applied, cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.4 FACTORY FINISHES

A. Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be electrogalvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements, installation tolerances, and other conditions affecting performance

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 INSTALLATION

A. Install thrust limits at centerline of thrust, symmetrical on either side of equipment.

B. Install resilient bolt isolation washers on equipment anchor bolts.

3.3 EQUIPMENT BASES

A. Fill concrete inertia bases, after installing base frame, with 3000-psi concrete; trowel to a smooth finish.

B. Concrete Bases: Anchor equipment to concrete base according to supported equipment manufacturer's written instructions for seismic codes at Project site.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. Isolator deflection.

3.5 ADJUSTING

A. Adjust isolators after piping systems have been filled and equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.

D. Adjust active height of spring isolators.

3.6 CLEANING

A. After completing equipment installation, inspect vibration isolation and seismic-control devices. Remove paint splatters and other spots, dirt, and debris.

END OF SECTION 230548

SECTION 230553 - 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.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White

C. Background Color: Red

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White .

C. Background Color: Black

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass beaded chain.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 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 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting".

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:

1. Refrigerant Piping:

    a. Background Color: Black.
    b. Letter Color: Yellow.

3.4 DUCT LABEL INSTALLATION

A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue For cold-air supply ducts.
2. Yellow For hot-air supply ducts.
3. Green For exhaust-, outside-, relief-, return-, and mixed-air ducts.
4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

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:

1. Valve-Tag Size and Shape:

    a. Chilled Water: 2 inches, round.
    b. Condenser Water: 2 inches, round.
    c. Refrigerant: 2 inches, round.
    d. Hot Water: 2 inches, round.
    e. Gas: 2 inches, round.

2. Valve-Tag Color:

    a. Chilled Water: Blue.
    b. Condenser Water: Yellow.
    c. Refrigerant: Black.
    d. Hot Water: Red.
    e. Gas: Yellow.

3. Letter Color:

    a. Chilled Water: White.
    b. Condenser Water: Black.
    c. Refrigerant: White.
    d. Hot Water: White.
    e. Gas: Black.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 230593 - 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. Pre-demolition air measurements shall be taken prior to demolition. See the contract drawings for additional information.

2. Balancing Air Systems:

a. Constant-volume air 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: Submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Certified TAB reports.

C. Sample report forms.

D. 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 AABC, NEBB or TABB.

B. TAB Report Forms: Use standard TAB contractor's forms approved by Engineer

C. 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.

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 and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in 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 three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 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 in accordance with the following:

1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
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 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 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.

3.7 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.8 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.9 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 monthly 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.

3.10 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.

3. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm .
b. Total system static pressure in inches wg .
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg .
f. Preheat-coil static-pressure differential in inches wg.
g. Cooling-coil static-pressure differential in inches wg.
h. Heating-coil static-pressure differential in inches wg.
i. Outdoor airflow in cfm.
j. Return airflow in cfm.
k. Outdoor-air damper position.
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.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.
o. Inlet steam pressure in psig.

G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btu/h.
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and rpm.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches, and bore.
n. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm.
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.
d. Air temperature differential in deg F.
e. Entering-air static pressure in inches wg.
f. Leaving-air static pressure in inches wg.
g. Air static-pressure differential in inches wg.
h. Low-fire fuel input in Btu/h.
i. High-fire fuel input in Btu/h.
j. Manifold pressure in psig.

k. High-temperature-limit setting in deg F.
l. Operating set point in Btu/h.
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btu/h.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.

e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated air flow rate in cfm.
h. Indicated velocity in fpm.
i. Actual air flow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

J. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Air velocity in fpm.
c. Preliminary air flow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final air flow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.

d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

M. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.

e. Dates of calibration.

3.11 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 Engineer
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Engineer
3. 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.

3.12 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 230593

SECTION 230700 - 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. Calcium silicate.
b. Cellular glass.
c. Flexible elastomeric.
d. Mineral fiber.
e. Phenolic.
f. Polyisocyanurate.
g. Polyolefin.
h. Polystyrene.

2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Lagging adhesives.
7. Sealants.
8. Factory-applied jackets.
9. Field-applied fabric-reinforcing mesh.
10. Field-applied cloths.
11. Field-applied jackets.
12. Tapes.
13. Securements.
14. Corner angles.

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. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.

1. Sample Sizes:

a. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
b. Sheet Form Insulation Materials: 12 inches square.
c. Jacket Materials for Pipe: 12 inches long by NPS 2.
d. Sheet Jacket Materials: 12 inches square.
e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

D. Qualification Data: For qualified Installer.

E. 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.

F. 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.

C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Piping Mockups:

    a. One 10-foot section of NPS 2 straight pipe.
    b. One each of a 90-degree threaded, welded, and flanged elbow.
    c. One each of a threaded, welded, and flanged tee fitting.
    d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
    e. Four support hangers including hanger shield and insert.
    f. One threaded strainer and one flanged strainer with removable portion of insulation.
    g. One threaded reducer and one welded reducer.
    h. One pressure temperature tap.
    i. One mechanical coupling.

2. Ductwork Mockups:

    a. One 10-foot section each of rectangular and round straight duct.
    b. One each of a 90-degree mitered round and rectangular elbow, and one each of a 90-degree radius round and rectangular elbow.
    c. One rectangular branch takeoff and one round branch takeoff from a rectangular duct. One round tee fitting.
    d. One rectangular and round transition fitting.
    e. Four support hangers for round and rectangular ductwork.

3. Equipment Mockups:

    a. One chilled-water pump and one heating-hot-water pump.
    b. One tank or vessel.

4. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
5. Notify Engineer seven days in advance of dates and times when mockups will be constructed.
6. Obtain Engineer's approval of mockups before starting insulation application.

7. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.

8. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
9. Demolish and remove mockups when directed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. 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.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

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

    a. Cell-U-Foam Corporation; Ultra-CUF.
    b. Pittsburgh Corning Corporation; Foamglas Super K.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.

5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
6. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

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

    a. Aeroflex USA Inc.; Aerocel.
    b. Armacell LLC; AP Armaflex.
    c. Rubatex Corp.
    d. Armstrong World Industries, Inc.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II without facing and with all service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil and vinyl film

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

    a. CertainTeed Corp.; Duct Wrap.
    b. Johns Manville; Microlite.
    c. Knauf Insulation; Duct Wrap.
    d. Manson Insulation Inc.; Alley Wrap.
    e. Owens Corning; All-Service Duct Wrap.

I. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB. without facing and with all service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil and vinyl film

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

    a. CertainTeed Corp.; Commercial Board.
    b. Fibrex Insulations Inc.; FBX.
    c. Johns Manville; 800 Series Spin-Glas.
    d. Knauf Insulation; Insulation Board.
    e. Manson Insulation Inc.; AK Board.
    f. Owens Corning; Fiberglas 700 Series.

J. Mineral-Fiber, Preformed Pipe Insulation:

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

    a. Fibrex Insulations Inc.; Coreplus 1200.
    b. Johns Manville; Micro-Lok.
    c. Knauf Insulation; 1000 Pipe Insulation.
    d. Manson Insulation Inc.; Alley-K.
    e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with all purpose factory applied vapor-retarder jacket.

3. Type II, 1200 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with all purpose factory applied vapor-retarder jacket.

K. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less.

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

    a. CertainTeed Corp.; CrimpWrap.
    b. Johns Manville; MicroFlex.
    c. Knauf Insulation; Pipe and Tank Insulation.
    d. Manson Insulation Inc.; AK Flex.
    e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

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

a. Insulco, Division of MFS, Inc.; Triple I.
b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

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

a. P. K. Insulation Mfg. Co., Inc.; Thermal-V-Kote.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

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

a. Insulco, Division of MFS, Inc.; SmoothKote.
b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

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

a. Aeroflex USA Inc.; Aeroseal.
b. Armacell LCC; 520 Adhesive.
c. Foster Products Corporation, H. B. Fuller Company; 85-75.
d. RBX Corporation; Rubatex Contact Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

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

a. Childers Products, Division of ITW; CP-96.
b. Foster Products Corporation, H. B. Fuller Company; 81-33.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

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

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

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

a. Dow Chemical Company (The); 739, Dow Silicone.
b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Speedline Vinyl Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

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

a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.
f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F .
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

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

a. Childers Products, Division of ITW; CP-30.
b. Foster Products Corporation, H. B. Fuller Company; 30-35.
c. ITW TACC, Division of Illinois Tool Works; CB-25.
d. Marathon Industries, Inc.; 501.
e. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F .
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

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

a. Childers Products, Division of ITW; Encacel.
b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
c. Marathon Industries, Inc.; 570.
d. Mon-Eco Industries, Inc.; 55-70.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F .
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

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

a. Childers Products, Division of ITW; CP-52.

b. Foster Products Corporation, H. B. Fuller Company; 81-42.
c. Marathon Industries, Inc.; 130.
d. Mon-Eco Industries, Inc.; 11-30.
e. Vimasco Corporation; 136.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 deg F.
4. Color: White.

2.6 SEALANTS

A. Metal Jacket Flashing Sealants:

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

a. Childers Products, Division of ITW; CP-76-8.
b. Foster Products Corporation, H. B. Fuller Company; 95-44.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. PVC Jacket Flashing Sealants:

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

a. Childers Products, Division of ITW; CP-76.
b. Foster Products Corporation, H. B. Fuller Company; 95-44.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.

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

a. Childers Products, Division of ITW; Chil-Glas No. 5.

b. Vimasco Corporation; Elastafab 894.

B. Woven Glass-Fiber Fabric for Duct and Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.

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

a. Childers Products, Division of ITW; Chil-Glas No. 5.
b. Vimasco Corporation; Elastafab 894.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

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

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto PVC Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.

3. Color: White
4. Factory-fabricated fitting covers to match jacket.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

5. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:

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

   a. Childers Products, Division of ITW; Metal Jacketing Systems.
   b. PABCO Metals Corporation; Surefit.
   c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.

   a. Factory cut and rolled to size.
   b. Finish and thickness are indicated in field-applied jacket schedules.

   c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper .
   d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
   e. Factory-Fabricated Fitting Covers:

      1) Same material, finish, and thickness as jacket.
      2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      3) Tee covers.
      4) Flange and union covers.
      5) End caps.
      6) Beveled collars.
      7) Valve covers.
      8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

D. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

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

   a. Pittsburgh Corning Corporation; Pittwrap.
   b. Polyguard; Insulrap No Torch 125.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

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

   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.

b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils .
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

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

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
b. Compac Corp.; 110 and 111.
c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches .
3. Thickness: 6.5 mils .
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

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

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
b. Compac Corp.; 130.
c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
d. Venture Tape; 1506 CW NS.

2. Width: 2 inches .
3. Thickness: 6 mils .
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

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

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
b. Compac Corp.; 120.
c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

A. Bands:

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

a. Childers Products; Bands.
b. PABCO Metals Corporation; Bands.
c. RPR Products, Inc.; Bands.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 0.015 inch thick, 3/4 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209 , Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.

4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.

2. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; CD.
3) Midwest Fasteners, Inc.; CD.
4) Nelson Stud Welding; TPA, TPC, and TPS.

3. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; Cupped Head Weld Pin.
3) Midwest Fasteners, Inc.; Cupped Head.
4) Nelson Stud Welding; CHP.

4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; RC-150.
2) GEMCO; R-150.
3) Midwest Fasteners, Inc.; WA-150.
4) Nelson Stud Welding; Speed Clips.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

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

D. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized steel.

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

a. C & F Wire.
b. Childers Products.
c. PABCO Metals Corporation.
d. RPR Products, Inc.

2.11 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch , aluminum according to ASTM B 209 , Alloy 3003, 3005, 3105 or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch , stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of 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. Provide an additional one hundred hundred feet of preformed insulation and one hundred square feet of blanket and board type insulation as well as accessories and labor for each size, thickness and type used on the project to accommodate any changes required to resolve interferences or as directed by the Engineer.

I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

J. Install insulation with least number of joints practical.

K. 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.

L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

M. 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 4 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.

N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

P. 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.

Q. 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" and fire-resistive joint sealers.

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 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.

2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    d. Do not overcompress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins and attach speed washers.
    g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches .
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.

2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch-diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from aluminum, at least 0.060 inch thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.6 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.

3.7 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch , and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
   2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of cellular-glass insulation to valve body.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.

3.8 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch , and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.

f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.10 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.

4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.11 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

3.12 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.13 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. Inspect ductwork, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to ten location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
2. Inspect field-insulated equipment, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to ten location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
3. Inspect pipe, fittings, strainers, and valves, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to ten locations of straight pipe, ten locations of threaded fittings, ten locations of welded fittings, five locations of threaded strainers, five locations of welded strainers, ten locations of threaded valves, and ten locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.14 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in nonconditioned space.
4. Indoor, exposed return located in nonconditioned space.
5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
7. Indoor, concealed oven and warewash exhaust.
8. Indoor, exposed oven and warewash exhaust.
9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
11. Outdoor, concealed supply and return.
12. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Factory-insulated plenums and casings.
2. Flexible connectors.
3. Vibration-control devices.
4. Factory-insulated access panels and doors.

3.15 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

B. Concealed, round and flat-oval, return-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

C. Concealed, round and flat-oval, outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

D. Concealed, round and flat-oval, exhaust-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

E. Concealed, rectangular, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

F. Concealed, rectangular, return-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

G. Concealed, rectangular, outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

H. Concealed, rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

I. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket; thickness as required to achieve 2-hour fire rating.

J. Concealed, supply-air plenum insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

K. Concealed, return-air plenum insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

L. Concealed, outdoor-air plenum insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

M. Concealed, exhaust-air plenum insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

N. Exposed, round and flat-oval, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

O. Exposed, round and flat-oval, return-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

P. Exposed, round and flat-oval, outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

Q. Exposed, round and flat-oval, exhaust-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

R. Exposed, rectangular, supply-air duct insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick 3-lb/cu. ft. nominal density.

S. Exposed, rectangular, return-air duct insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick 3-lb/cu. ft. nominal density.

T. Exposed, rectangular, outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick 3-lb/cu. ft. nominal density.

U. Exposed, rectangular, exhaust-air duct insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick 3-lb/cu. ft. nominal density.

V. Exposed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated board, thickness as required to achieve 2-hour fire rating.

W. Exposed, supply-air plenum insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick 3-lb/cu. ft. nominal density.

X. Exposed, return-air plenum insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick 3-lb/cu. ft. nominal density.

Y. Exposed, outdoor-air plenum insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick 3-lb/cu. ft. nominal density.

Z. Exposed, exhaust-air plenum insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick 3-lb/cu. ft. nominal density.

3.16 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Exposed, round and flat-oval, supply-air duct insulation shall be the following:

1. Extruded Close Cell Polystyrene Foam Board (Foamular 150): 2 inches thick.

B. Exposed, round and flat-oval, return-air duct insulation shall be the following:

1. Extruded Close Cell Polystyrene Foam Board (Foamular 150): 2 inches thick.

C. Exposed, rectangular, supply-air duct insulation shall be the following:

1. Extruded Close Cell Polystyrene Foam Board (Foamular 150): 2 inches thick.

D. Exposed, rectangular, return-air duct insulation shall be the following:

1. Extruded Close Cell Polystyrene Foam Board (Foamular 150): 2 inches thick.

E. Exposed, supply-air plenum insulation shall be the following:

1. Extruded Close Cell Polystyrene Foam Board (Foamular 150): 2 inches thick.

F. Exposed, return-air plenum insulation shall be the following:

1. Extruded Close Cell Polystyrene Foam Board (Foamular 150): 2 inches thick.

3.17 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.18 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F :

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1-1/2 inches thick.

C. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1-1/2 inches thick.

3.19 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 2 inches thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 2 inches thick.

3.20 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:

1. Paper and Foil with Vapor Retarder

D. Ducts and Plenums, Exposed:

1. Painted Aluminum, Smooth: 0.032 inches thick.

E. Equipment, Concealed:

1. Paper and Foil with Vapor Retarder

F. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches :

1. PVC 30 mils thick.

G. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches :

1. Painted Aluminum, Smooth 0.032 inch thick.

H. Piping, Concealed:

1. Paper and Foil with Vapor Retarder

I. Piping, Exposed:

1. PVC 30 mils thick.

3.21 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:

1. Aluminum, Smooth 0.040 inch thick.

D. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:

1. Five (5) Ply Aluminum Self Adhesive Vapor Barrier (VentureClad 1577CW), Vapor Retarder, Aluminum finish with Stucco Embossed Texture. Provide Foil Insulation Tape (VentureTape 1520CW), Heavy Duty FSK Facing Tape (VentureTape 1549CW), and foil vapor seal tape (VentureTape 1540CW).

E. Ducts and Plenums, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches :

1. Five (5) Ply Aluminum Self Adhesive Vapor Barrier (VentureClad 1577CW), Vapor Retarder, Aluminum finish with Stucco Embossed Texture. Provide Foil Insulation Tape (VentureTape 1520CW), Heavy Duty FSK Facing Tape (VentureTape 1549CW), and foil vapor seal tape (VentureTape 1540CW).

F. Piping, Concealed:

1. Aluminum, Smooth 0.040 inch thick.

G. Piping, Exposed:

1. Aluminum, Smooth 0.040 inch thick.

3.22 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material. 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

END OF SECTION 230700

SECTION 230993 - SEQUENCE OF OPERATION

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.

2. SUMMARY

    a. This Section includes control sequences for HVAC systems, subsystems, and equipment.

    b. Related Sections include the following:

        1. Specification Section 230900 - Building Automation System

        2. Applicable Division 23 Specification Sections for equipment manufacturer supplied control devices and instrumentation.

    c. See the control system schematics for additional details and information.

3. Sequence of Operation: VARIABLE AIR VOLUME SYSTEM

    Rooftop Unit VAV Air System:

    Note:
    This sequence of operations describes the “system-level” control functions of a rooftop unit (RTU) with VAV terminal units that are part of the air system, which includes coordinating the operation of the RTU and the zone-level VAV units during the various operating modes. The “equipment-level” control functions of the RTU and the terminal units are contained in their respective sequence of operations documents.

    System Operating Modes:

    The Building Automation System (BAS) controller shall include a user-adjustable time-of-day schedule to define when the various areas of the facility are expected to be occupied versus unoccupied. Then, based on current zone conditions, the BAS determines the current system operating mode. The BAS controller shall send the following operating modes to the unit level controllers that are a member of the air system: Occupied Heat/Cool, Unoccupied Heat/Cool and Morning Warmup/Pre-cool.

Occupied Heat/Cool:

During the Occupied Mode, each VAV terminal unit shall be activated to maintain zone temperature at the occupied setpoint (cooling or heating). Meanwhile, the rooftop unit (RTU) modulates the supply fan to deliver the required airflow to the zones, positions the outdoor-air damper to bring in required amount of ventilation, and increases/decreases the source of cooling or heating to maintain discharge air at the desired setpoint.

Unoccupied Heat/Cool:

During the Unoccupied Mode, each VAV terminal unit shall be activated to maintain zone temperature at the unoccupied setpoint (cooling or heating). Meanwhile, the RTU shuts off, unless a zone requires unoccupied cooling or heating. If needed to operate, the RTU modulates the supply fan to deliver the required airflow to the zones, closes the outdoor-air damper and increases/decreases the source of cooling or heating to maintain discharge air at the desired setpoint.

Morning Warm-Up/Pre-Cool:

During the Morning Warm-up/Pre-cool Mode, each VAV terminal shall be activated to raise or lower the zone temperature to the occupied setpoint (heating or cooling) and then closes. Meanwhile, the RTU modulates the supply fan to deliver the required airflow to the zones, closes the outdoor-air damper and increases/decreases the source of cooling or heating to maintain discharge air at the desired setpoint.

Refrigerant Mitigation Mode:

Upon mitigation activation, the Variable Air System (VAS) application in the BAS will override all identified VAV members to fully open during mitigation while disabling electric heat in any VAV terminals equipped with it.

In occupied mode, the VAS will release all overrides once the mitigation action has concluded.

In unoccupied mode, after the mitigation action has concluded, the VAS application will release all overrides, except for the designated boxes that remain overridden in unoccupied mode in preparation for future leak detection and mitigation.

Optimized System-Level Control Sequences:

The BAS controller shall perform the following optimized system-level control strategies:

Optimal Start:

The BAS shall initiate Optimal Start mode such that the RTU is started and VAV boxes are enabled to allow the zone temperature to reach the occupied heating or cooling setpoint prior to scheduled occupancy. The system shall wait as long as possible before starting, so that the temperature in each zone reaches the occupied setpoint just in time for scheduled occupancy.

Optimal Stop:

The BAS shall initiate Optimal Stop mode such that cooling or heating is disabled so that the zone temperature does not drift beyond the occupied standby setpoint by the end of the scheduled occupancy period. The RTU supply fan shall continue operating, and ventilation control shall continue, through the end of the scheduled occupancy period.

Unoccupied Economizing (Night Purge):

Between 4:00 AM (adj.) and 6:00 AM (adj), the system controller shall initiate Unoccupied Economizing mode if the current zone temperature is at least 1°F warmer than the occupied cooling setpoint and the outdoor dry-bulb temperature is more than 15°F (adj) cooler than the current zone temperature. When initiated, the RTU is started (OA damper fully open, cooling source is off) and VAV boxes are enabled to allow the zone temperature to cool to the occupied cooling setpoint.

Optimized Control of Supply Duct Static Pressure (Fan-Pressure Optimization):

At a frequency of once every 2 minutes (adj), the system controller shall monitor the damper position and airflow of all VAV terminal units. The system controller shall calculate a new supply fan duct static pressure setpoint based on the criteria shown below, and send this newly-calculated setpoint to the AHU controller.

All values below are adjustable:

1. If the measured airflow is less than 50% of set point while set point is greater than zero and the damper position is greater than 95% for 1 minute, send 3 requests.

2. Else if the measured airflow is less than 70% of set point while set point is greater than zero and the damper position is greater than 95% for 1 minute, send 2 requests.

3. Else if the damper position is greater than 95%, send 1 request until the damper position is less than 85%.

4. Else if the damper position is less than 95%, send 0 requests.

System shall default to ignoring the first 2 requests (adj). When Requests > Ignores the system shall respond by adjusting setpoint upward by (Requests – Ignores) * .06 inH20 (adj), but no larger than .13 inH20 (adj). When Requests are equal to, or less than

Ignores the setpoint shall be reset downward by -.05 inH20 (adj). Setpoint shall be bound by a minimum and maximum value which can be set per air handler.

Optimized Control of Discharge Air Temperature (DAT Reset):

At a frequency of once every 2 minutes (adj), the system controller shall monitor the outdoor dry-bulb temperature, as well as the zone temperature and damper position of all VAV terminal units. The system controller shall calculate a new discharge air temperature (DAT) setpoint based on the criteria shown below, and send this newly-calculated DAT setpoint to the RTU controller. When the outdoor air (OA) temperature is warmer than 65°F (adj), the maximum DAT setpoint shall be 55°F (adj). When the OA temperature is colder than 55°F (adj), the maximum DAT setpoint shall be 65°F (adj). When the OA temperature is between 55°F (adj) and 65°F (adj), the maximum DAT setpoint shall be reset proportionally between 55°F (adj) and 65°F (adj).

All values below are adjustable.

1. If the zone temperature exceeds the zone's cooling set point by 5°F for 2 minutes, send 3 requests.

2. Else if the zone temperature exceeds the zone's cooling set point by 3°F for 2 minutes, send 2 requests.

3. Else if the cooling loop is greater than 95%, send 1 request until the cooling loop is less than 85%.

4. Else if the cooling loop is less than 95%, send 0 requests.

System shall default to ignoring the first 2 requests (adj). When Requests > Ignores the system shall respond by adjusting setpoint downward by (Requests – Ignores) * -0.3°F (adj), but no larger than 1.0 °F (adj). When Requests are equal to, or less than Ignores the setpoint shall be reset upward by 0.2°F (adj). Setpoint shall be bound by a minimum and maximum value which can be set per air handler.

Optimized Control of Ventilation (Demand-Controlled Ventilation) with RTU Return Air CO2:

When the BAS time-of-day schedule indicates that a zone is occupied, if the CO2 concentration measured in the zone rises above the desired upper limit, the VAV controller shall modulate the VAV damper further open. Increasing primary airflow results in more outdoor air delivered to the zone, but may activate local or remote heat (if equipped) to prevent the zone from over cooling. Concurrently, the RTU controller shall adjust the position of the outdoor-air damper in response to the CO2 concentration measured in the common return-air duct.

4. Sequence of Operation: PACKAGED RTU (RTU-1) (MZVAV)

   Building Automation System Interface:

   The Building Automation System (BAS) shall send the controller Occupied Bypass, Morning Warm-up/Pre-Cool, Occupied/Unoccupied and Heat/Cool modes. The BAS shall also send the discharge air temperature setpoint and the duct static pressure setpoint. If a BAS is not present, or communication is lost with the BAS the controller shall operate using default modes and setpoints.

   Occupied:

   During occupied periods, the supply fan shall run continuously and the mixed air dampers shall open to maintain minimum ventilation requirements. The unit controller shall control the supply fan speed to maintain the current supply duct static pressure setpoint (adj.). Upon a call for DX cooling, the unit controller shall enable the variable speed compressor. The compressor shall start at its minimum speed and then adjust the speed to maintain the active discharge air temperature setpoint. The gas heat shall be enabled and controlled to maintain the active discharge air temperature setpoint. If economizing is enabled, the outdoor air or mixed air dampers shall modulate to maintain the discharge air temperature setpoint and the relief air damper shall track the mixed air dampers. If the discharge air temperature sensor fails, the DX cooling shall be disabled, the gas heat shall be disabled, and an alarm shall annunciate at the BAS.

   Unoccupied:

   When the space temperature is below the unoccupied heating setpoint of 60.0 deg. F (adj.) the supply fan shall be commanded on, the outside air damper shall remain closed and the gas heat shall be enabled. When the space temperature rises above the unoccupied heating setpoint of 60.0 deg. F (adj.) plus the unoccupied differential of 4.0 deg. F (adj.) the supply fan shall stop and the gas heat shall be disabled. When the space temperature is above the unoccupied cooling setpoint of 85.0 deg. F (adj.) the supply fan shall be commanded on, the outside air damper shall open if economizing is enabled and remain closed if economizing is disabled and the DX cooling shall be enabled. When the space temperature falls below the unoccupied cooling setpoint of 85.0 deg. F minus the Unoccupied differential of 4.0 deg. F (adj.) the supply fan shall stop, the DX cooling shall be disabled and the outside air damper shall close.

   Optimal Start:

   The BAS shall monitor the scheduled occupied time, occupied space setpoints and space temperature to calculate when the optimal start occurs.

Optimal Stop:

The BAS shall monitor the scheduled unoccupied time, occupied setpoints and space temperature to calculate when the optimal stop occurs. When the optimal stop mode is active the unit controller shall maintain the space temperature to the space temperature offset setpoint. Outside air damper shall remain enabled to provide minimum ventilation.

Morning Warm-Up Mode:

During optimal start, if the average space temperature is below the occupied heating setpoint a morning warm-up mode shall be activated. When morning warm-up is initiated the unit shall enable the heating and fan(s). The outside air damper shall remain closed. When the space temperature reaches the occupied heating setpoint (adj.), the unit shall transition to the occupied mode.

Pre-Cool Mode:

During optimal start, if the average space temperature is above the occupied cooling setpoint, pre-cool mode shall be activated. When pre-cool is initiated the unit shall enable the fan and cooling or economizer. The outside air damper shall remain closed, unless economizing. When the space temperature reaches occupied cooling setpoint (adj.), the unit shall transition to the occupied mode.

Occupied Bypass:

The BAS shall monitor the status of the ON and CANCEL buttons of the space temperature sensors. When an occupied bypass request is received from a space sensor, the unit shall transition from its current occupancy mode to occupied bypass mode and the unit shall maintain the space temperature to the occupied setpoints (adj.).

Heat/Cool Mode:

COOLING: The unit controller shall use the discharge air temperature sensor and discharge air temperature cooling setpoint to determine when to initiate requests for cooling. Discharge air setpoint shall be maintained by controlling the cooling as required.

HEATING: The unit controller shall use the discharge air temperature sensor and discharge air temperature heating setpoint to determine when to initiate requests for heating. Discharge air setpoint shall be maintained by controlling the heating as required. During Unoccupied Heating or Morning Warm-Up Mode, the unit heat request shall be communicated to the system VAVs prior to commencing heating operation to allow VAV units to open. The variable frequency drive shall be commanded to 100% and the heat shall be staged on and off to satisfy the zone temperature setpoint.

Discharge Air Temperature Reset Control:

The discharge air temperature setpoint shall be reset to the optimal setpoint communicated by the BAS. The BAS shall reset the discharge air temperature setpoint based on the current outside air temperature, but shall override this reset function and return the discharge air temperature setpoint to 55.0 deg. F (adj.) if more than two (adj.) zones begin to overheat. Also, the BAS shall override this reset function whenever outdoor dew point is higher than 60.0 deg. F (adj.) or indoor humidity is higher than 60% RH (adj.). If the discharge air temperature drops below the minimum limit, a low temperature alarm shall annunciate and the unit shall shut down. If the discharge air temperature rises above the maximum limit, a high temperature alarm shall annunciate.

Economizer:

ENABLE (Comparative Enthalpy): Outside air (OA) enthalpy shall be compared with Return air (RA) enthalpy point. The economizer shall enable when OA enthalpy is less than RA enthalpy - 2.0 BTU/LB. The economizer shall disable when OA enthalpy is greater than RA enthalpy.

OPERATION: The supply air sensor shall measure the dry bulb temperature of the air leaving the evaporator coil while economizing. When economizing is enabled and the unit is operating in the cooling mode, the economizer damper shall be modulated between its minimum position and 100% to maintain the discharge air temperature setpoint. The economizer damper shall modulate toward minimum position in the event the discharge air temperature falls below the discharge low limit temperature setpoint. Compressors shall be delayed from operating until the economizer has opened to 100%.

Demand Control Ventilation (DCV):

If the return air CO2 level is greater than or equal to the Design Minimum CO2 Setpoint, the outdoor air damper shall open to the Design Minimum Outdoor Air Damper Setpoint. If there is a call for economizer cooling, the damper may be opened further to satisfy the cooling request.

If the return air CO2 level is less than or equal to the DCV Minimum CO2 Setpoint, the outdoor air damper shall close to the DCV Minimum Outdoor Air Damper Setpoint. If there is a call for economizer cooling, the damper may be opened further to satisfy the cooling request.

If the return air CO2 level is greater than the DCV Minimum CO2 Setpoint and less than the Design Minimum CO2 Setpoint, the outdoor air damper position shall be modulated proportionally to the return CO2 level relative to a target position between the DCV Minimum CO2 Setpoint and the Design Minimum CO2 Setpoint. If there is a call for economizer cooling, the damper may be opened further to satisfy the cooling request.

Supply Fan:

The supply fan shall be enabled while in the occupied mode and cycled on during the unoccupied mode.

Supply Duct Static Pressure Control:

During the occupied mode the unit controller shall modulate the output to the variable frequency drive as required to maintain the supply duct static pressure setpoint of 1.5 inches of W.C. (adj.). If the supply duct static pressure falls below 1.3 inches of W.C. (adj.) the unit controller shall increase the output to the variable frequency drive to maintain setpoint. If the supply duct static pressure rises above 1.7 inches of W.C. (adj.) the unit controller shall decrease the output to the variable frequency drive to maintain setpoint. Upon a call for heating or cooling in the unoccupied mode the unit controller shall modulate the speed of the variable frequency drive to 100%.

Static Pressure High Limit:

If for any reason the supply air pressure exceeds the supply air pressure high limit, the supply fan shall shut down. The unit shall be allowed to restart three times after a 15 minute off period. If the overpressurization condition occurs on the fourth restart, the unit shall shut down and a manual reset diagnostic is displayed at the remote panel and/or the BAS system. If for any reason the supply air pressure exceeds the fixed supply air pressure limit of 3.5 inches of W.C. the supply fan shall shut down. The unit shall be allowed to restart three times. If the over pressurization condition occurs on the fourth restart, the unit shall shut down and a manual reset diagnostic is displayed at the remote panel and/or the BAS system.

Relief Air and Building Pressure Control:

The relief air fan shall enable when the economizer damper position is equal to or greater than the relief air fan setpoint.

Filter Status:

A differential pressure switch shall monitor the differential pressure across the filter(s) when the fan is running. If the switch closes during normal operation a dirty filter alarm shall annunciate at the BAS.

Condensate Overflow Shutdown:

The unit shall shut down in response to a signal from the condensate overflow sensor. The sensor shall be interlocked to the unit cooling controller for immediate shutdown of cooling.

Refrigerant Mitigation Mode:

The unit controller will monitor the leak detection system, when a leak is detected, an alarm will promptly alert the BAS via BACnet Change-of-Value (COV) and mitigation will be activated.

In occupied mode, the supply fan will remain operational, and the compressor(s) will be disabled for the duration of the mitigation process plus an additional 5 minutes.

In unoccupied mode, the supply fan will activate within 15 seconds while the compressor(s) will be disabled for the duration of the mitigation process plus an additional 5 minutes.

5. Sequence of Operation: VAV TERMINAL UNIT

   Building Automation System Interface:

   The Building Automation System (BAS) shall send the controller Occupied, and Unoccupied commands. The BAS may also send a Heat/Cool mode, priority shutdown commands, space temperature and/or space temperature setpoint. If communication is lost with the BAS, the controller shall operate using its local setpoints.

   Occupied:

   The occupancy mode will be communicated or hardwired to the controller via a binary input. When the unit is in the occupied mode the VAV will maintain the space temperature at the active occupied heating or cooling setpoint. Applicable ventilation and airflow setpoints will be enforced. The occupied mode will be the default mode of the VAV. Applicable ventilation and airflow setpoints will be enforced. The occupied mode will be the default mode of the VAV.

   Occupied Standby:

   The occupancy mode will be communicated or hardwired to the controller via a binary input, even though the BAS has scheduled the space as occupied. In the occupied standby mode, the active cooling and heating setpoints shall be relaxed (see cooling and heating mode) and both the ventilation airflow and minimum airflow setpoints shall be lowered (see VAV schedule).

   Unoccupied:

   Normal operating mode for unoccupied spaces or nighttime operation. When the unit is in unoccupied mode the VAV controller will maintain the space temperature at the stored unoccupied heating or cooling setpoint regardless of the presence of a hardwired or

communicated setpoint. When the space temperature drops below its Unoccupied Heating Setpoint, the controller will modulate the air damper and the hot water valve until the zone temperature rises back to 2.0 deg. F above the Unoccupied Heating Setpoint. When the space temperature exceeds the active unoccupied setpoint the hot water valve will the air damper and hot water valve will modulate fully closed.

Occupied Bypass:

Mode used to temporarily place the unit into the occupied operation. Tenants shall be able to override the unoccupied mode from the space sensor. The override shall last for a maximum of 4 hours (adj.). The tenants shall be able to cancel the override from the space sensor at any time. During the override the unit shall operate in occupied mode.

Heat/Cool Mode:

The Heat/Cool mode shall be set by a communicated value or automatically by the VAV. In standalone or auto mode the VAV shall compare the primary air temperature with the configured auto changeover setpoint to determine if the air is "hot" or "cold". Heating mode implies the primary air temperature is hot. Cooling mode implies the primary air temperature is cold.

Cooling Mode:

When the unit is in cooling mode, the VAV controller shall maintain the space temperature at the active cooling setpoint by modulating the airflow between the active cooling minimum airflow setpoint to the maximum cooling airflow setpoint. The VAV shall use the measured space temperature and the active cooling setpoint to determine the requested cooling capacity of the unit. The outputs will be controlled based on the unit configuration and the requested cooling capacity.

Based on the VAV controller occupancy mode, the active cooling setpoint will be one of the following:

Setpoint	Default Value
Occupied Cooling Setpoint	74.0 deg. F
Unoccupied Cooling Setpoint	85.0 deg. F
Occupied Standby Cooling Setpoint	78.0 deg. F
Occupied Min Cooling Airflow Setpoint	See VAV Schedule
Occupied Max Cooling Airflow Setpoint	See VAV Schedule

Heat/Cool Setpoint:

The space temperature setpoint shall be determined either by a local (e.g., thumbwheel) setpoint, the VAV default setpoint or a communicated value. The VAV shall use the locally stored default setpoints when neither a local setpoint nor communicated setpoint

is present. If both a local setpoint and communicated setpoint exist, the VAV shall use the communicated value.

Reheat Control Mode:

Reheat will only be allowed when the supply air temperature is 5.0 deg. F below the configured reheat enable setpoint of 70.0 deg. F (adj.). The reheat will be enabled when the space temperature drops below the active heating setpoint and the minimum airflow requirements are met. During reheat the VAV will operate at its minimum heating airflow setpoint and energize the heat as follows:

Setpoint	Default Value
Occupied Heating Setpoint	71.0 deg. F
Unoccupied Heating Setpoint	60.0 deg. F
Occupied Standby Heating Setpoint	67.0 deg. F
Occupied Min Heating Airflow Setpoint	See VAV Schedule
Occupied Max Heating Airflow Setpoint	See VAV Schedule

Heating Mode:
When the unit is in heating mode, the VAV controller will maintain the space temperature at the active heating setpoint by modulating the VAV damper (between the active heating minimum and maximum airflow setpoints). Based on the VAV controller occupancy mode, the active heating setpoint will be one of the following:

Setpoint	Default Value
Occupied Heating Setpoint	71.0 deg. F
Unoccupied Heating Setpoint	60.0 deg. F
Occupied Standby Heating Setpoint	67.0 deg. F
Occupied Min Heating Airflow Setpoint	See VAV Schedule
Occupied Max Heating Airflow Setpoint	See VAV Schedule

Local Reheat Control:

Reheat will only be allowed when the primary air temperature is 5.0 deg. F below the configured reheat enable setpoint of 70.0 deg. F (adj.). The reheat shall be enabled when the space temperature drops below the active heating setpoint and the minimum airflow requirements are met. During reheat the VAV shall operate at its minimum heating airflow setpoint and energize the heat as follows:

Electric Silicon Controlled Rectifier Reheat (SCR):

If the space temperature is at the heating setpoint, the electric heater shall modulate as required to maintain space temperature at the active heating setpoint while the VAV operates at its minimum heating airflow setpoint. If the discharge air temperature reaches the design heating discharge air temperature setpoint (adj.), the VAV shall modulate

airflow between the minimum heating airflow setpoint and the maximum heating airflow setpoint as required to maintain space temperature at the active heating setpoint, while the electric heater modulates to maintain discharge air temperature at the design heating discharge air temperature setpoint. If the airflow reaches the maximum heating airflow setpoint, the VAV shall modulate the electric heater as required to maintain space temperature at the active heating setpoint, while the VAV operates at its maximum heating airflow setpoint

Demand Control Ventilation:

When the unit is in unoccupied mode, the ventilation airflow setpoint will be zero. When the unit is in occupied mode, the ventilation airflow setpoint shall equal the design outdoor airflow (see VAV schedule).

The current ventilation airflow setpoint shall be communicated to the BAS for control of the system outdoor-air intake.

Space Sensor Failure:

If there is a fault with the operation of the zone sensor an alarm shall be annunciated at the BAS. Space sensor failure shall cause the VAV to drive the damper to minimum air flow if the VAV is in the occupied mode, or drive it closed if the VAV is in the unoccupied mode.

Space Humidity Monitoring:

The VAV Box will monitor the space humidity.

Sequence of Operation: PACKAGED RTU (RTU-2) (SZVAV)

6. Building Automation System Interface:

   The Building Automation System (BAS) shall send the controller Occupied Bypass, Morning Warm-up/Pre-Cool, Occupied/Unoccupied and Heat/Cool modes. If a BAS is not present, or communication is lost with the BAS the controller shall operate using default modes and setpoints.

   Occupied:

   During occupied periods, the supply fan shall run continuously and the mixed air dampers shall open to maintain minimum ventilation requirements. Upon a call for DX cooling, the unit controller shall enable the first fixed speed compressor. If the fixed speed compressor cannot satisfy the load conditions, the unit controller shall start the next fixed speed compressor in sequence to add to the total unit cooling load percentage. This process shall repeat until all of the fixed speed compressors have been started or until the

active space temperature setpoint is satisfied. The gas heat shall be enabled and controlled to maintain the active space temperature setpoint. If economizing is enabled, the outdoor air or mixed air dampers shall modulate to maintain the discharge air temperature setpoint and the relief air damper shall track the mixed air dampers. The discharge air temperature setpoint shall be dynamically reset based on the deviation of actual space temperature from the active space temperature setpoint. If the discharge air temperature sensor fails, the DX cooling and the gas heat shall control to maintain the active space temperature setpoint and an alarm shall annunciate at the BAS. If the discharge air temperature sensor and the space temperature sensor fail, the DX cooling shall be disabled, the gas heat shall be disabled, and an alarm shall annunciate at the BAS.

Unoccupied:

When the space temperature is below the unoccupied heating setpoint of 60.0 deg. F (adj.) the supply fan shall be commanded on, the outside air damper shall remain closed and the gas heat shall be enabled. When the space temperature rises above the unoccupied heating setpoint of 60.0 deg. F (adj.) plus the unoccupied differential of 4.0 deg. F (adj.) the supply fan shall stop and the gas heat shall be disabled. When the space temperature is above the unoccupied cooling setpoint of 85.0 deg. F (adj.) the supply fan shall be commanded on, the outside air damper shall open if economizing is enabled and remain closed if economizing is disabled and the DX cooling shall be enabled. When the space temperature falls below the unoccupied cooling setpoint of 85.0 deg. F minus the Unoccupied differential of 4.0 deg. F (adj.) the supply fan shall stop, the DX cooling shall be disabled and the outside air damper shall close.

Optimal Start:

The BAS shall monitor the scheduled occupied time, occupied space setpoints and space temperature to calculate when the optimal start occurs.

Optimal Stop:

The BAS shall monitor the scheduled unoccupied time, occupied setpoints and space temperature to calculate when the optimal stop occurs. When the optimal stop mode is active the unit controller shall maintain the space temperature to the space temperature offset setpoint. Outside air damper shall remain enabled to provide minimum ventilation.

Morning Warm-Up Mode:

During optimal start, if the space temperature is below the occupied heating setpoint a morning warm-up mode shall be activated. When morning warm-up is initiated the unit shall enable the heating and fan(s). The outside air damper shall remain closed. When the

space temperature reaches the occupied heating setpoint (adj.), the unit shall transition to the occupied mode.

Pre-Cool Mode:

During optimal start, if the space temperature is above the occupied cooling setpoint, pre-cool mode shall be activated. When pre-cool is initiated the unit shall enable the fan and cooling or economizer. The outside air damper shall remain closed, unless economizing. When the space temperature reaches occupied cooling setpoint (adj.), the unit shall transition to the occupied mode.

Occupied Bypass:

The BAS shall monitor the status of the ON and CANCEL buttons of the space temperature sensor. When an occupied bypass request is received from a space sensor, the unit shall transition from its current occupancy mode to occupied bypass mode and the unit shall maintain the space temperature to the occupied setpoints (adj.).

Heat/Cool Mode:

When the space temperature rises above the occupied cooling setpoint the mode shall transition to cooling. When the space temperature falls below the occupied heating setpoint the mode shall transition to heating. When the space temperature is above the occupied cooling setpoint or below the occupied heating setpoint the mode shall remain in its last state. If the space temperature sensor fails the mode shall remain in its last state and an alarm shall annunciate at the BAS. If the local and communicated setpoints fail the controller shall disable the supply fan and an alarm shall annunciate at the BAS.

Dehumidification:

The unit shall be in dehumidification mode if the space humidity is above the dehumidification setpoint. In the dehumidification mode, the supply air fan shall be enabled, the outside air damper shall be commanded to minimum position, and the unit controller shall energize mechanical cooling and the hot gas reheat coil shall modulate.

MULTI-CIRCUIT UNITS: During dehumidification mode the outside air temperature shall be monitored. If this temperature rises above the reheat capacity limit setpoint or falls below the reheat capacity limit setpoint – 3.0 deg. F (adj.), the unit shall stage down or stage up the compressors respectively to meet full or part load capacity requirements based on ambient temperature. Factory installed hot gas reheat shall allow application of dehumidification. Dehumidification shall be allowed only when the outside air temperature is above 40.0 deg. F and below 100.0 deg. F. The economizer outside air damper shall drive to minimum position during dehumidification.

MULTI-CIRCUIT UNITS: On a call for dehumidification, the hot gas reheat valve in circuit 1 shall energize and the compressor(s) shall enable. When the humidity control setpoint is satisfies, the valve shall be de-energized and the compressor(s) in circuit 1 shall be disabled. If there is a call for 1st stage cooling while in the dehumidification mode, no action shall take place. If there is a call for 2nd stage cooling, the hot gas reheat valve shall be de-energized, and the unit shall revert to the cooling mode. If 2nd stage cooling is satisfied and there is still a call for dehumidification, the hot gas reheat valve shall once again be energized.

Economizer:

ENABLE (Comparative Enthalpy): Outside air (OA) enthalpy shall be compared with Return air (RA) enthalpy point. The economizer shall enable when OA enthalpy is less than RA enthalpy - 2.0 BTU/LB. The economizer shall disable when OA enthalpy is greater than RA enthalpy.

OPERATION: The supply air sensor shall measure the dry bulb temperature of the air leaving the evaporator coil while economizing. When economizing is enabled and the unit is operating in the cooling mode, the economizer damper shall modulate between its minimum position and 100% to maintain the space temperature setpoint. Minimum position shall be calculated based on supply fan speed. If the supply air temperature starts to fall below supply air temperature setpoint, the outdoor damper shall be at minimum position. Compressors shall be delayed from operating until the economizer has opened to 100% for 5 minutes.

Demand Control Ventilation (DCV):

If the return air CO2 level is greater than or equal to the Design Minimum CO2 Setpoint, the outdoor air damper shall open to the Design Minimum Outdoor Air Damper Setpoint. If there is a call for economizer cooling, the damper may be opened further to satisfy the cooling request.

If the return air CO2 level is less than or equal to the DCV Minimum CO2 Setpoint, the outdoor air damper shall close to the DCV Minimum Outdoor Air Damper Setpoint. If there is a call for economizer cooling, the damper may be opened further to satisfy the cooling request.

If the return air CO2 level is greater than the DCV Minimum CO2 Setpoint and less than the Design Minimum CO2 Setpoint, the outdoor air damper position shall be modulated proportionally to the return CO2 level relative to a target position between the DCV Minimum CO2 Setpoint and the Design Minimum CO2 Setpoint. If there is a call for economizer cooling, the damper may be opened further to satisfy the cooling request.

Supply Fan:

The unit controller shall vary the supply fan speed to optimize minimum fan speed in all cooling and heating modes.

Relief Air and Building Pressure Control:

The relief air fan shall enable when the economizer damper position is equal to or greater than the relief air fan setpoint.

Filter Status:

A differential pressure switch shall monitor the differential pressure across the filter(s) when the fan is running. If the switch closes during normal operation a dirty filter alarm shall annunciate at the BAS.

Condensate Overflow Shutdown:

The unit shall shut down in response to a signal from the condensate overflow sensor. The sensor shall be interlocked to the unit cooling controller for immediate shutdown of cooling.

Refrigerant Mitigation Mode:

The unit controller will monitor the leak detection system, when a leak is detected, an alarm will promptly alert the BAS via BACnet Change-of-Value (COV) and mitigation will be activated.

In occupied mode, the supply fan will remain operational, and the compressor(s) will be disabled for the duration of the mitigation process plus an additional 5 minutes.

In unoccupied mode, the supply fan will activate within 15 seconds while the compressor(s) will be disabled for the duration of the mitigation process plus an additional 5 minutes.

Sequence of Operation: ELECTRIC CABINET UNIT HEATERS

Building Automation System Interface:
The Building Automation System (BAS) shall send the controller Occupied Bypass, Morning Warm-up, Occupied/Unoccupied and Heat/Cool modes. If a BAS is not present, or communication is lost with the BAS the controller shall operate using default modes and setpoints

Occupied:

During occupied periods, the supply fan shall run continuously. The electric heat shall control to maintain the active space temperature setpoint.

Unoccupied:
When the space temperature is below the unoccupied heating setpoint of 60.0 deg. F (adj.) the supply fan shall start and the electric heat shall be enabled. When the space temperature rises above the unoccupied heating setpoint of 60.0 deg. F (adj.) plus the unoccupied differential of 4.0 deg. F (adj.) the supply fan shall stop and the electric heat shall be disabled.

Optimal Start:
The BAS shall monitor the scheduled occupied time, occupied space setpoints and space temperature to calculate when the optimal start occurs.

Morning Warm-Up Mode:
During optimal start, if the space temperature is below the occupied heating setpoint a morning warm-up mode shall be activated. When morning warm-up is initiated the unit shall enable the heating and supply fan. When the space temperature reaches the occupied heating setpoint (adj.), the unit shall transition to the occupied mode.

Optimal Stop:
The BAS shall monitor the scheduled unoccupied time, occupied setpoints and space temperature to calculate when the optimal stop occurs. When the optimal stop mode is active the unit controller shall maintain the space temperature to the space temperature offset setpoint.

Occupied Bypass:
The BAS shall monitor the status of the ON and CANCEL buttons of the space temperature sensor. When an occupied bypass request is received from a space sensor, the unit shall transition from its current occupancy mode to occupied bypass mode and the unit shall maintain the space temperature to the occupied setpoints (adj.).

Space Temperature Control:
Cascade zone control shall be used in the occupied, occupied bypass, and occupied standby modes. It maintains zone temperature by controlling the discharge air temperature to control the zone temperature while minimizing the fan speed. The space temperature shall be maintained at the occupied heating setpoint of 71.0 deg. F (adj.).

Supply Fan Operation:
The supply fan shall cycle on demand during the unoccupied mode. When the controller transitions to the occupied mode, the supply fan shall start at high speed before transitioning to continuous operation at the selected speed. The supply fan status shall be monitored by a differential pressure switch. If the supply fan fails the fan shall be commanded off and an alarm shall annunciate at the BAS. A manual reset shall be required to restart the fan.

Filter Timer:

The fan-run time (hrs) shall be compared to the filter maintenance timer setpoint. Once the setpoint is reached a filter timer alarm diagnostic shall be annunciated at the BAS. When the diagnostic is cleared, the filter-maintenance timer is reset to zero, and the timer begins accumulating fan-run time again.

Sequence of Operation: EXHAUST FANS

Building Automation System Interface:
The Building Automation System (BAS) shall send the controller an Occupied or Unoccupied command. If a BAS is not present, or communication is lost with the BAS, the controller shall operate in the Occupied mode.

Occupied:
During occupied periods, the exhaust fan shall run continuously.

Unoccupied:
During unoccupied periods the exhaust fan shall be disabled.

Fan Status:
The fan status shall be monitored by a differential pressure switch. If the fan is signaled to start, and status is not proven within 20 seconds (adj.), an alarm shall annunciate at the BAS.
NOTE: C/T switch is not an acceptable method for fan status.

END OF SECTION 230993

SECTION 231123 - FACILITY 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.
5. Pressure regulators.
6. Service meters.
7. Concrete bases.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 100 psig minimum unless otherwise indicated.

3. Minimum Operating Pressure of Service Meter: 65 psig .

B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig, and is reduced to secondary pressure of 0.5 psig or less.

C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Corrugated, stainless-steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Service meters. Indicate pressure ratings and capacities. Include bypass fittings and meter bars
6. Dielectric fittings.

B. Shop Drawings: For facility 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, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

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. Delegated-Design Submittal: For natural-gas piping and equipment 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. Detail fabrication and assembly of seismic restraints.
2. Design Calculations: Calculate requirements for selecting seismic restraints.

D. 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.

E. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

F. Qualification Data: For qualified professional engineer.

G. Welding certificates.

H. Field quality-control reports.

I. Operation and Maintenance Data: For motorized gas valves, pressure regulators and service meters to include in emergency, operation, and maintenance manuals.

1.6 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.

1.7 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.

1.8 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Architect, Construction Manager, Owner and Engineer no fewer than ten days in advance of proposed interruption of natural-gas service.

2. Do not proceed with interruption of natural-gas service without Construction Manager's and Owner's written permission.

1.9 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

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. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

    a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

6. 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. Stainless-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.

B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.

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

a. OmegaFlex, Inc.
b. Parker Hannifin Corporation; Parflex Division.
c. Titeflex.
d. Tru-Flex Metal Hose Corp.

2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
3. Coating: PE with flame retardant.

a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1) Flame-Spread Index: 25 or less.
2) Smoke-Developed Index: 50 or less.

4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
5. Striker Plates: Steel, designed to protect tubing from penetrations.
6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
7. Operating-Pressure Rating: 5 psig.

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig .

6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches .

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 60 mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig .

D. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig .

E. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig .

F. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. 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.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig .
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.

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

a. BrassCraft Manufacturing Company; a Masco company.

b. Conbraco Industries, Inc.; Apollo Div.
c. Lyall, R. W. & Company, Inc.
d. McDonald, A. Y. Mfg. Co.
e. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated brass.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Separate packnut with adjustable-stem packing threaded ends.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig .
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

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

a. BrassCraft Manufacturing Company; a Masco company.
b. Conbraco Industries, Inc.; Apollo Div.
c. Lyall, R. W. & Company, Inc.
d. McDonald, A. Y. Mfg. Co.
e. Perfection Corporation; a subsidiary of American Meter Company.
f. .

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig (4140 kPa).
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.

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

a. BrassCraft Manufacturing Company; a Masco company.
b. Conbraco Industries, Inc.; Apollo Div.
c. Lyall, R. W. & Company, Inc.
d. McDonald, A. Y. Mfg. Co.
e. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig .
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Bronze Plug Valves: MSS SP-78.

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

a. Lee Brass Company.
b. McDonald, A. Y. Mfg. Co.

2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

H. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

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

a. McDonald, A. Y. Mfg. Co.
b. Mueller Co.; Gas Products Div.
c. Xomox Corporation; a Crane company.

2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig .
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

I. Cast-Iron, Lubricated Plug Valves: MSS SP-78.

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

    a. Flowserve.
    b. Homestead Valve; a division of Olson Technologies, Inc.
    c. McDonald, A. Y. Mfg. Co.
    d. Milliken Valve Company.
    e. Mueller Co.; Gas Products Div.
    f. R&M Energy Systems, A Unit of Robbins & Myers, Inc.

2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig .
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

J. PE Ball Valves: Comply with ASME B16.40.

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

    a. Kerotest Manufacturing Corp.
    b. Lyall, R. W. & Company, Inc.
    c. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: PE.
3. Ball: PE.
4. Stem: Acetal.
5. Seats and Seals: Nitrile.
6. Ends: Plain or fusible to match piping.
7. CWP Rating: 80 psig
8. Operating Temperature: Minus 20 to plus 140 deg F
9. Operator: Nut or flat head for key operation.
10. Include plastic valve extension.
11. Include tamperproof locking feature for valves where indicated on Drawings.

K. Valve Boxes:

1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches (125 mm) in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.5 MOTORIZED GAS VALVES

A. Automatic Gas Valves: Comply with ANSI Z21.21.

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

a. ASCO Power Technologies, LP; Division of Emerson.
b. Dungs, Karl, Inc.
c. Eaton Corporation; Controls Div.
d. Eclipse Combustion, Inc.
e. Honeywell International Inc.
f. Johnson Controls.

2. Body: Brass or aluminum.
3. Seats and Disc: Nitrile rubber.
4. Springs and Valve Trim: Stainless steel.
5. Normally closed.
6. Visual position indicator.
7. Electrical operator for actuation by appliance automatic shutoff device.

B. Electrically Operated Valves: Comply with UL 429.

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

a. ASCO Power Technologies, LP; Division of Emerson.
b. Dungs, Karl, Inc.
c. Eclipse Combustion, Inc.
d. Goyen Valve Corp.; Tyco Environmental Systems.
e. Magnatrol Valve Corporation.
f. Parker Hannifin Corporation; Climate & Industrial Controls Group; Skinner Valve Div.
g. Watts Regulator Co.; Division of Watts Water Technologies, Inc.

2. Pilot operated.
3. Body: Brass or aluminum.
4. Seats and Disc: Nitrile rubber.
5. Springs and Valve Trim: Stainless steel.
6. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
7. NEMA ICS 6, Type 4, coil enclosure.
8. Normally closed.
9. Visual position indicator.

2.6 EARTHQUAKE VALVES

A. Earthquake Valves: Comply with ASCE 25.

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

a. Vanguard Valves, Inc.

2. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
3. Maximum Operating Pressure: 5 psig .
4. Cast-aluminum body with nickel-plated chrome steel internal parts.
5. Nitrile-rubber valve washer.
6. Sight windows for visual indication of valve position.
7. Threaded end connections complying with ASME B1.20.1.
8. Wall mounting bracket with bubble level indicator.

B. Earthquake Valves: Comply with ASCE 25.

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

a. Pacific Seismic Products, Inc.

2. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
3. Maximum Operating Pressure: 7 psig

4. Cast-aluminum body with stainless-steel internal parts.
5. Nitrile-rubber, reset-stem o-ring seal.
6. Valve position, open or closed, indicator.
7. Composition valve seat with clapper held by spring or magnet locking mechanism.
8. Level indicator.
9. End Connections: Threaded for valves NPS 2 and smaller; flanged for valves NPS 2-1/2 and larger.

2.7 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Service Pressure Regulators: Comply with ANSI Z21.80.

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

   a. Actaris.
   b. American Meter Company.
   c. Fisher Control Valves and Regulators; Division of Emerson Process Management.
   d. Invensys.
   e. Richards Industries; Jordan Valve Div.
   .

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.

10. Overpressure Protection Device: Factory mounted on pressure regulator.

11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 100 psig (690 kPa).

C. Line Pressure Regulators: Comply with ANSI Z21.80.

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

    a. Actaris.
    b. American Meter Company.
    c. Eclipse Combustion, Inc.
    d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
    e. Invensys.
    f. Maxitrol Company.
    g. Richards Industries; Jordan Valve Div.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.

10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 5 psig (34.5 kPa).

D. Appliance Pressure Regulators: Comply with ANSI Z21.18.

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

    a. Canadian Meter Company Inc.
    b. Eaton Corporation; Controls Div.
    c. Harper Wyman Co.
    d. Maxitrol Company.
    e. SCP, Inc.

2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 2 psig

2.8 SERVICE METERS

A. Diaphragm-Type Service Meters: Comply with ANSI B109.1 and ANSI B109.2.

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

    a. Actaris.
    b. American Meter Company.
    c. Invensys.

2. Case: Die-cast aluminum.
3. Connections: Steel threads.
4. Diaphragm: Synthetic fabric.
5. Diaphragm Support Bearings: Self-lubricating.

6. Compensation: Continuous temperature and pressure.
7. Meter Index: Cubic feet and liters.
8. Meter Case and Index: Tamper resistant.
9. Remote meter reader compatible.
10. Maximum Inlet Pressure: 100 psig.
11. Pressure Loss: Maximum 0.5-inch wg.
12. Accuracy: Maximum plus or minus 1.0 percent.

B. Rotary-Type Service Meters: Comply with ANSI B109.3.

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

    a. American Meter Company.
    b. Invensys.

2. Case: Extruded aluminum.
3. Connection: Flange.
4. Impellers: Polished aluminum.

5. Rotor Bearings: Self-lubricating.

6. Compensation: Continuous temperature and pressure.
7. Meter Index: Cubic feet and liters.
8. Tamper resistant.
9. Remote meter reader compatible.
10. Maximum Inlet Pressure: 100 psig .
11. Accuracy: Maximum plus or minus 2.0 percent.

C. Turbine Meters: Comply with ASME MFC-4M.

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

    a. American Meter Company.
    b. Invensys.

2. Housing: Cast iron or welded steel.
3. Connection Threads or Flanges: Steel.
4. Turbine: Aluminum or plastic.
5. Turbine Bearings: Self-lubricating.

6. Compensation: Continuous temperature and pressure.
7. Meter Index: Cubic feet and liters.
8. Tamper resistant.
9. Remote meter reader compatible.
10. Maximum Inlet Pressure: 100 psig .
11. Accuracy: Maximum plus or minus 2.0 percent.

D. Service-Meter Bars:

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

    a. Actaris.
    b. American Meter Company.
    c. Lyall, R. W. & Company, Inc.
    d. McDonald, A. Y. Mfg. Co.
    e. Mueller Co.; Gas Products Div.
    f. Perfection Corporation; a subsidiary of American Meter Company.

2. Malleable- or cast-iron frame for supporting service meter.
3. Include offset swivel pipes, meter nuts with o-ring seal, and factory- or field-installed dielectric unions.

4. Omit meter offset swivel pipes if service-meter bar dimensions match service-meter connections.

E. Service-Meter Bypass Fittings:

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

   a. Lyall, R. W. & Company, Inc.
   b. Williamson, T. D., Inc.

2. Ferrous, tee, pipe fitting with capped side inlet for temporary natural-gas supply.
3. Integral ball-check bypass valve.

2.9 DIELECTRIC FITTINGS

A. Dielectric Unions:

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

   a. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Hart Industries International, Inc.
   d. McDonald, A. Y. Mfg. Co.
   e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
   f. Wilkins; Zurn Plumbing Products Group.

2. Minimum Operating-Pressure Rating: 150 psig .
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

B. Dielectric Flanges:

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

   a. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
   d. Wilkins; Zurn Plumbing Products Group.

2. Minimum Operating-Pressure Rating: 150 psig .
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.

5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

C. Dielectric-Flange Kits:

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

a. Advance Products & Systems, Inc.
b. Calpico Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Minimum Operating-Pressure Rating: 150 psig.
3. Companion-flange assembly for field assembly.
4. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
5. Insulating materials suitable for natural gas.
6. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.10 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

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 the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.

2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

E. Copper Tubing with Protective Coating:

1. Apply joint cover kits over tubing to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.

F. Install fittings for changes in direction and branch connections.

G. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.4 INDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code 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. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Provide an additional seventy five feet of gas piping and accessories and installation labor for each size of pipe used on the project to accommodate any changes required to resolve interferences or as directed by the engineer.

N. 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 long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

O. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

P. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

Q. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.

2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.

3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.

    a. Exception: Tubing passing through partitions or walls does not require striker barriers.

5. Prohibited Locations:

    a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
    b. Do not install natural-gas piping in solid walls or partitions.

R. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

S. Connect branch piping from top or side of horizontal piping.

T. 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.

U. Do not use natural-gas piping as grounding electrode.

V. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

W. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

X. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

Y. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

Z. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

3.5 SERVICE-METER ASSEMBLY INSTALLATION

A. Install service-meter assemblies aboveground, on concrete bases.

B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.

C. Install strainer on inlet of service-pressure regulator and meter set.

D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.

E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.

F. Install service meters downstream from pressure regulators.

G. Install metal bollards to protect meter assemblies. Comply with requirements in Division 05 Section "Metal Fabrications" for pipe bollards.

3.6 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install earthquake valves aboveground outside buildings according to listing.

E. Install anode for metallic valves in underground PE piping.

3.7 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. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

3.8 HANGER AND SUPPORT INSTALLATION

A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

B. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches ; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.

5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

CONNECTIONS

D. Connect to utility's gas main according to utility's procedures and requirements.

E. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

F. Install piping adjacent to appliances to allow service and maintenance of appliances.

G. 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.

H. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.9 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.

3.10 PAINTING

A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

a. Prime Coat: Alkyd anticorrosive metal primer.

b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Topcoat: Exterior alkyd enamel gloss.
d. Color: Yellow.

C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.

a. Prime Coat: Alkyd anticorrosive metal primer.

b. Intermediate Coat: Interior latex matching topcoat.
c. Topcoat: Interior latex gloss.
d. Color: Yellow.

D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to the International Fuel Gas Code 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.

3.12 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.13 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping shall be the following:

1. Steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.

B. Aboveground natural-gas piping shall be the following:

1. Steel pipe with wrought-steel fittings and welded joints.

C. Branch Piping in Cast-in-Place Concrete to Single Appliance: Annealed-temper copper tube with wrought-copper fittings and brazed joints. Install piping embedded in concrete with no joints in concrete.

D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

A. Aboveground, branch piping NPS 1 and smaller shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be the following:

1. Steel pipe with wrought-steel fittings and welded joints.

C. Underground, below building, piping shall be the following:

1. Steel pipe with wrought-steel fittings and welded joints.

D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.15 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5 PSIG

A. Aboveground, branch piping NPS 1 and smaller shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be the following:

1. Steel pipe with steel welding fittings and welded joints.

C. Underground, below building, piping shall be the following:

1. Steel pipe with wrought-steel fittings and welded joints.

D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat underground pipe and fittings with protective coating for steel piping.

E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.16 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 5 PSIG

A. Aboveground Piping: Maximum operating pressure more than 5 psig.

B. Aboveground, Branch Piping: Steel pipe with steel welding fittings and welded joints.

C. Aboveground, distribution piping shall be the following:

1. Steel pipe with steel welding fittings and welded joints.

D. Underground, below building, piping shall be the following:

1. Steel pipe with wrought-steel fittings and welded joints.

E. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

F. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.17 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.

B. Underground:

1. NPS 2-1/2 and Larger: Cast-iron, lubricated plug valves.

3.18 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller at service meter shall be the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.

B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.

C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.

D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.

E. Valves in branch piping for single appliance shall be the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION 231123

SECTION 232113 - 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. Condensate-drain piping.

1.3 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.

B. RTRF: Reinforced thermosetting resin (fiberglass) fittings.

C. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

1. Condensate-Drain Piping: 150 deg F.

1.5 SUBMITTALS

A. Product Data: For each type of the following:

1. Plastic pipe and fittings with solvent cement.
2. RTRP and RTRF with adhesive.
3. Pressure-seal fittings.
4. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.

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.

G. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.6 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.

2. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by the manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.

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.

1.7 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.

B. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. Wrought-Copper Fittings: ASME B16.22.

D. Wrought-Copper Unions: ASME B16.22.

2.2 PLASTIC PIPE AND FITTINGS

A. CPVC Plastic Pipe: ASTM F 441/F 441M, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.

B. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.

C. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.

D. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

    a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, 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 joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. 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.

G. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.

a. Use CPVC solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
b. 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).

2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

a. 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).
b. 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).

H. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.4 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

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

a. Charlotte Pipe and Foundry Company.
b. IPEX Inc.
c. KBi.

2. CPVC and PVC one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.

B. Plastic-to-Metal Transition Unions:

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

a. Charlotte Pipe and Foundry Company.
b. IPEX Inc.
c. KBi.
d. NIBCO INC.

2. MSS SP-107, CPVC and PVC union. Include brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union.

2.5 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:

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

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Hart Industries International, Inc.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.

2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges:

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

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits:

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

a. Advance Products & Systems, Inc.

b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. 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.

3. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings:

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

a. Calpico, Inc.
b. Lochinvar Corporation.

2. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

G. Dielectric Nipples:

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

a. Perfection Corporation; a subsidiary of American Meter Company.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Company, Inc.
d. Victaulic Company of America.

2. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.6 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Condensate-Drain Piping: Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

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 calibrated-orifice, balancing valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; 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. Provide an additional one-hundred feet of piping and accessories and installation labor for each size of pipe used on the project to accommodate any changes required to resolve interferences or as directed by the engineer.

P. 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.

Q. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

R. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

S. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

T. 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.

U. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

V. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.

4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
9. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 inch.
10. NPS 10: Maximum span, 20 feet; minimum rod size, 3/4 inch.
11. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
12. NPS 14: Maximum span, 25 feet; minimum rod size, 1 inch.
13. NPS 16: Maximum span, 27 feet; minimum rod size, 1 inch.
14. NPS 18: Maximum span, 28 feet; minimum rod size, 1-1/4 inches.
15. NPS 20: Maximum span, 30 feet; minimum rod size, 1-1/4 inches.

E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

F. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

G. Fiberglass Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

H. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

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.

3.6 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 232113

SECTION 233113 - 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. This Section includes rectangular, round, and flat-oval metal ducts and plenums for heating, ventilating, and air-conditioning systems in pressure classes from minus 2- to plus 10-inch wg.

2. The ductwork in the Auxiliary Gymnasium shall be double-wall rectangular ductwork. The ductwork shall be painted. Coordinate the color with the Owner. The Owner shall be provided with a color selection chart for selection of the color.

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.
3. Division 23 Section “Duct Insulation” for insulation for metal ducts.
4. Division 23 Section "Building Management System" for automatic volume-control dampers and operators.
5. Division 23 Section "Diffusers, Registers, and Grilles" for air terminals connected to metal ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and

Flexible" and ASCE/SEI 7, SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems.

1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

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. 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.

E. Welding certificates.

F. 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."

D. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," unless otherwise indicated.

E. Comply with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems," unless otherwise indicated.

F. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Chapter 3, "Duct System," for range hood ducts, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. McGill AirFlow LLC.
2. Sheet Metal Connectors, Inc.

B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.

4. Cover insulation with polyester film complying with UL 181, Class 1.

G. Inner Duct: Minimum 0.028-inch solid steel galvanized sheet steel.

H. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Traverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

I. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

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

a. Lindab Inc.
b. McGill AirFlow LLC.
c. SEMCO Incorporated.

d. Sheet Metal Connectors, Inc.
e. Spiral Manufacturing Co., Inc.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 DOUBLE-WALL ROUND DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Lindab Inc.
2. McGill AirFlow LLC.
3. SEMCO Incorporated.
4. Sheet Metal Connectors, Inc.

B. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

    a. Fabricate round ducts larger than 90 inch in diameter with butt-welded longitudinal seams.
    b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Inner Duct: Minimum 0.028-inch solid galvanized sheet steel.

D. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

2.5 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.

2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils thick on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 1 mil thick on opposite surface.
3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.

D. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

E. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

F. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

G. Factory- or Shop-Applied Antimicrobial Coating:

1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
5. Shop-Applied Coating Color: Black.
6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

H. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

I. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.6 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.

2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.8 SEISMIC-RESTRAINT DEVICES

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

1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Ductmate Industries, Inc.
3. Hilti Corp.
4. Kinetics Noise Control.
5. Loos & Co.; Cableware Division.
6. Mason Industries.
7. TOLCO; a brand of NIBCO INC.
8. Unistrut Corporation; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of the ICC Evaluation Service.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 492, stainless-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

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 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. Provide an extra 350 lbs of ductwork to accommodate ductwork revisions required to resolve interferences or as directed by the Engineer.

H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

I. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

J. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

K. 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.

L. 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.

M. 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 thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems." ASCE/SEI 7.

1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
2. Brace a change of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect 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. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.6 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.

3.7 PAINTING

A. Paint exterior of exposed ductwork with color as selected by the architect. Paint interior of metal ducts that are visible through registers and grilles. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.8 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. Supply Ducts with a Pressure Class of 2-Inch wg or Higher: Test duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.

b. Return Ducts with a Pressure Class of 2-Inch wg or Higher: Test duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.
c. Exhaust Ducts with a Pressure Class of 2-Inch wg or Higher: Test duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.
d. Outdoor Air Ducts with a Pressure Class of 2-Inch wg or Higher: Test duct sections totaling no less than 100 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.

3.9 DUCT CLEANING

A. Clean new and existing duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated.

B. All exposed round ductwork as shown on the contract drawings shall be double wall insulated spiral type. Coordinate finish color with Architect.

C. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

    a. Pressure Class: Positive 3-inch wg.
    b. Minimum SMACNA Seal Class: C.
    c. SMACNA Leakage Class for Rectangular: 6.
    d. SMACNA Leakage Class for Round and Flat Oval: 3.

2. Ducts Connected to Constant-Volume Air-Handling Units:

    a. Pressure Class: Positive 3-inch wg.
    b. Minimum SMACNA Seal Class: C.
    c. SMACNA Leakage Class for Rectangular: 6.
    d. SMACNA Leakage Class for Round and Flat Oval: 3.

D. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

    a. Pressure Class: Positive or negative 2-inch wg.
    b. Minimum SMACNA Seal Class: C.
    c. SMACNA Leakage Class for Rectangular: 6.
    d. SMACNA Leakage Class for Round and Flat Oval: 3.

2. Ducts Connected to Air-Handling Units:

    a. Pressure Class: Positive or negative 2-inch wg .
    b. Minimum SMACNA Seal Class: C.
    c. SMACNA Leakage Class for Rectangular: 6.
    d. SMACNA Leakage Class for Round and Flat Oval: 3.

E. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative 2-inch wg.
b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

F. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

G. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.
2. PVC-Coated Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Galvanized.

3. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.

b. Not Exposed to Airstream: Match duct material.

4. Aluminum Ducts: Aluminum.

H. Double-Wall Duct Interstitial Insulation:

1. Supply Air Ducts: 1 inch thick.
2. Return Air Ducts: 1 inch thick.
3. Exhaust Air Ducts: 1 inch thick.

I. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

a. Velocity 1000 fpm or Lower:

1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

c. Velocity 1500 fpm or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.

c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Welded.

J. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Control dampers.
5. Fire dampers.
6. Ceiling dampers.
7. Smoke dampers.
8. Combination fire and smoke dampers.
9. Corridor dampers.
10. Flange connectors.
11. Duct silencers.
12. Turning vanes.
13. Remote damper operators.
14. Duct-mounted access doors.
15. Flexible connectors.
16. Flexible ducts.
17. Duct security bars.
18. Duct accessory hardware.

B. Related Sections:

1. Division 23 Section "Metal Ducts”.

1.3 SUBMITTALS

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

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control damper installations.
d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Duct security bars.

f. Wiring Diagrams: For power, signal, and control wiring.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

D. Source quality-control reports.

E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

1.5 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and a polished finish for exposed ducts.

D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

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

1. Air Balance Inc.; a division of Mestek, Inc.
2. American Warming and Ventilating; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Duro Dyne Inc.
5. Greenheck Fan Corporation.
6. Lloyd Industries, Inc.
7. Nailor Industries Inc.
8. NCA Manufacturing, Inc.
9. Pottorff; a division of PCI Industries, Inc.
10. Ruskin Company.
11. SEMCO Incorporated.

12. Vent Products Company, Inc.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2200 fpm.

D. Maximum System Pressure: 2-inch wg.

E. Frame: 0.052-inch- thick, galvanized sheet steel with welded corners and mounting flange.

F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Neoprene, mechanically locked.

I. Blade Axles:

1. Material: Plated steel.
2. Diameter: 0.20 inch.

J. Tie Bars and Brackets: Galvanized steel.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.

5. Screen Mounting: Front mounted in sleeve.

a. Sleeve Thickness: 20-gage minimum.
b. Sleeve Length: 6 inches minimum.

6. Screen Material: Galvanized steel or Aluminum.
7. Screen Type: Insect.
8. 90-degree stops.

2.3 BAROMETRIC RELIEF DAMPERS

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

1. Air Balance Inc.; a division of Mestek, Inc.
2. American Warming and Ventilating; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Duro Dyne Inc.
5. Greenheck Fan Corporation.
6. Lloyd Industries, Inc.
7. Nailor Industries Inc.
8. NCA Manufacturing, Inc.
9. Pottorff; a division of PCI Industries, Inc.
10. Ruskin Company.
11. SEMCO Incorporated.
12. Vent Products Company, Inc.

B. Suitable for horizontal or vertical mounting.

C. Maximum Air Velocity: 2200 fpm.

D. Maximum System Pressure: 2-inch wg.

E. Frame: 0.064-inch- thick, galvanized sheet steel, with welded corners and mounting flange.

F. Blades:

1. Multiple, 0.025-inch- thick, roll-formed aluminum.
2. Maximum Width: 6 inches.
3. Action: Parallel.
4. Balance: Gravity.
5. Eccentrically pivoted.

G. Blade Seals: Neoprene.

H. Blade Axles: Galvanized steel.

I. Tie Bars and Brackets:

1. Material: Galvanized steel.
2. Rattle free with 90-degree stop.

J. Return Spring: Adjustable tension.

K. Bearings: Synthetic or Stainless steel.

L. Accessories:

1. Flange on intake.
2. Adjustment device to permit setting for varying differential static pressures.

2.4 MANUAL VOLUME DAMPERS

A. Low-Leakage, Steel, Manual Volume Dampers:

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

    a. Air Balance Inc.; a division of Mestek, Inc.
    b. American Warming and Ventilating; a division of Mestek, Inc.
    c. Flexmaster U.S.A., Inc.
    d. McGill AirFlow LLC.
    e. METALAIRE, Inc.
    f. Nailor Industries Inc.
    g. Pottorff; a division of PCI Industries, Inc.
    h. Ruskin Company.
    i. Trox USA Inc.
    j. Vent Products Company, Inc.

2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
3. Suitable for horizontal or vertical applications.
4. Frames:

    a. Hat, U, Angle shaped.
    b. Galvanized-steel channels, 0.064 inch thick.
    c. Mitered and welded corners.
    d. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Galvanized, roll-formed steel, 0.064 inch thick.

6. Blade Axles: Galvanized steel.
7. Bearings:

    a. Oil-impregnated bronze, Molded synthetic, Stainless-steel sleeve.
    b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Blade Seals: Vinyl or Neoprene.
9. Jamb Seals: Cambered aluminum.
10. Tie Bars and Brackets: Galvanized steel.
11. Accessories:

    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

B. Low-Leakage, Aluminum, Manual Volume Dampers:

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

    a. Air Balance Inc.; a division of Mestek, Inc.
    b. American Warming and Ventilating; a division of Mestek, Inc.
    c. Flexmaster U.S.A., Inc.
    d. McGill AirFlow LLC.
    e. METALAIRE, Inc.
    f. Nailor Industries Inc.
    g. Pottorff; a division of PCI Industries, Inc.
    h. Ruskin Company.
    i. Trox USA Inc.
    j. Vent Products Company, Inc.

2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat, U, Angle-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.

    c. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
    d. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.

6. Blade Axles: Stainless steel.
7. Bearings:

    a. Oil-impregnated bronze, Molded synthetic, Stainless-steel sleeve.
    b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Blade Seals: Vinyl or Neoprene.

9. Jamb Seals: Cambered aluminum.
10. Tie Bars and Brackets: Aluminum.
11. Accessories:

    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

C. Jackshaft:

1. Size: 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

D. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.5 CONTROL DAMPERS

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

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Duro Dyne Inc.
5. Flexmaster U.S.A., Inc.
6. Greenheck Fan Corporation.
7. Lloyd Industries, Inc.
8. M&I Air Systems Engineering; Division of M&I Heat Transfer Products Ltd.
9. McGill AirFlow LLC.
10. METALAIRE, Inc.
11. Metal Form Manufacturing, Inc.
12. Nailor Industries Inc.
13. NCA Manufacturing, Inc.
14. Ruskin Company.
15. Vent Products Company, Inc.
16. Young Regulator Company.

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:

1. Hat, U, Angle] shaped.
2. Galvanized-steel channels, 0.064 inch thick.
3. Mitered and welded corners.

D. Blades:

1. Multiple blade with maximum blade width of 8 inches.

2. Parallel- and opposed-blade design.
3. Galvanized steel.
4. 0.064 inch thick.

5. Blade Edging: Closed-cell neoprene edging.

E. Blade Axles: 1/2-inch- diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

F. Bearings:

1. Oil-impregnated bronze, Molded synthetic or Stainless-steel sleeve.
2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.6 FIRE DAMPERS

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

1. Air Balance Inc.; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. McGill AirFlow LLC.
6. METALAIRE, Inc.
7. Nailor Industries Inc.
8. NCA Manufacturing, Inc.
9. PHL, Inc.
10. Pottorff; a division of PCI Industries, Inc.

11. Prefco; Perfect Air Control, Inc.
12. Ruskin Company.
13. Vent Products Company, Inc.
14. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Type: Static; rated and labeled according to UL 555 by an NRTL.

C. Fire Rating: 1-1/2 and 3 hours.

D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

I. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.7 SMOKE DAMPERS

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

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. PHL, Inc.
6. Ruskin Company.

B. General Requirements: Label according to UL 555S by an NRTL.

C. Smoke Detector: Integral, factory wired for single-point connection.

D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

E. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

F. Leakage: Class I .

G. Rated pressure and velocity to exceed design airflow conditions.

H. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

I. Damper Motors: Modulating or two-position action.

J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section "Instrumentation and Control for HVAC." Division 26 Sections.
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 115 V, single phase, 60 Hz.

K. Accessories:

1. Auxiliary switches for signaling fan control or position indication.
2. Momentary test switch, remote mounted.

2.8 FLANGE CONNECTORS

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

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.9 DUCT SILENCERS

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

1. Industrial Noise Control, Inc.
2. McGill AirFlow LLC.
3. Ruskin Company.
4. Vibro-Acoustics.

B. General Requirements:

1. Factory fabricated.
2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.

3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

C. Shape:

1. Rectangular straight with splitters or baffles.
2. Round straight with center bodies or pods.
3. Rectangular elbow with splitters or baffles.
4. Round elbow with center bodies or pods.
5. Rectangular transitional with splitters or baffles.

D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel, 0.040 inch thick.

E. Round Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel.

1. Sheet Metal Thickness for Units up to 24 Inches in Diameter: 0.034 inch thick.
2. Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: 0.040 inch thick.
3. Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: 0.052 inch thick.
4. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 0.064 inch thick.

F. Inner Casing and Baffles: ASTM A 653/A 653M, G90 galvanized sheet metal, 0.034 inch thick, and with 1/8-inch- diameter perforations.

G. Special Construction:

1. Suitable for outdoor use.
2. High transmission loss to achieve STC 45.

H. Connection Sizes: Match connecting ductwork unless otherwise indicated.

I. Principal Sound-Absorbing Mechanism:

1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
2. Dissipative type with fill material.

    a. Fill Material: Moisture-proof nonfibrous material.
    b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.

3. Lining: Mylar.

J. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.

1. Flange connections.
2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
3. Reinforcement: Cross or trapeze angles for rigid suspension.

K. Accessories:

1. Factory-installed end caps to prevent contamination during shipping.
2. Removable splitters.
3. Airflow measuring devices.

L. Source Quality Control: Test according to ASTM E 477.

1. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 2000-fpm face velocity.
2. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.

2.10 TURNING VANES

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

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.
4. SEMCO Incorporated.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

E.

F. Vane Construction: Single wall for ducts up to 8 inches wide and double wall for larger dimensions.

2.11 DUCT-MOUNTED ACCESS DOORS

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

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.

4. Flexmaster U.S.A., Inc.
5. Greenheck Fan Corporation.
6. McGill AirFlow LLC.
7. Nailor Industries Inc.
8. Pottorff; a division of PCI Industries, Inc.
9. Ventfabrics, Inc.
10. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."

1. Door:

    a. Double wall, rectangular.
    b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    c. Vision panel.
    d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
    e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

    a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
    b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
    c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches[with outside and inside handles.
    d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.

4. Factory set at 10-inch wg.
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.12 DUCT ACCESS PANEL ASSEMBLIES

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

1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. 3M.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.

D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.13 FLEXIBLE CONNECTORS

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

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd..
2. Minimum Tensile Strength: 500 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.

1. Minimum Weight: 16 oz./sq. yd..
2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

H. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.

1. Minimum Weight: 14 oz./sq. yd..
2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

I. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.14 FLEXIBLE DUCTS

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

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.

4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.

C. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

2.15 DUCT SECURITY BARS

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

1. Carnes.
2. KEES, Inc.
3. Lloyd Industries, Inc.
4. Metal Form Manufacturing, Inc.
5. Price Industries.

B. Description: Field- or factory-fabricated and field-installed duct security bars.

C. Configuration:

1. Frame: 10 gage by 2 inches.
2. Sleeve: 3/16-inch, continuously welded steel frames with 1-by-1-by-3/16-inch angle frame factory welded to 1 end and furnished loose for field welding on other end. To be poured in place or set with concrete block or welded or bolted to wall, one side only. Duct connections on both sides.
3. Horizontal Bars: 1/2 inch.
4. Vertical Bars: 3/4 inch.
5. Bar Spacing: 6 inches.
6. Mounting: Ductwork or other framing.

2.16 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire dampers according to UL listing.

H. Install duct security bars. Construct duct security bars from 0.164-inch steel sleeve, continuously welded at all joints and 1/2-inch- diameter steel bars, 6 inches o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch hinged access panel with cam lock in duct in each side of sleeve.

I. Connect ducts to duct silencers rigidly.

J. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.

6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.

7. At each change in direction and at maximum 50-foot spacing.
8. Upstream from turning vanes.
9. Upstream or downstream from duct silencers.
10. Control devices requiring inspection.
11. Elsewhere as indicated.

K. Install access doors with swing against duct static pressure.

L. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

M. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

N. Install flexible connectors to connect ducts to equipment.

O. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

P. Connect terminal units to supply ducts directly.

Q. Connect diffusers or light troffer boots to ducts directly or with maximum 10’-0” lengths of flexible duct clamped or strapped in place.

R. Connect flexible ducts to metal ducts with stainless steel clamps.

S. Install duct test holes where required for testing and balancing purposes.

T. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233423 - HVAC POWER VENTILATORS

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. Centrifugal roof ventilators.
2. Ceiling-mounting ventilators.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual Project site elevations.

B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Wiring Diagrams: Power, signal, and control wiring.
2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

C. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Roof framing and support members relative to duct penetrations.
   2. Ceiling suspension assembly members.
   3. Size and location of initial access modules for acoustical tile.
   4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Belts: two set(s) for each belt-driven unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

   1. Centrifugal Roof Ventilators:
      a. Cook, Loren Company (Basis of Design).
      b. Greenheck Fan Corp.
      c. Penn Ventilation Companies, Inc.
      d. Or Approved Equal.
   2. Ceiling-Mounting Ventilators:
      a. Cook, Loren Company (Basis of Design).
      b. Greenheck Fan Corp.
      c. Penn Ventilation Companies, Inc.
      d. Or Approved Equal.

2.2 CENTRIFUGAL ROOF VENTILATORS

A. Description: Belt-driven and direct-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories as scheduled on the contract drawings.

B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:

1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
4. Fan and motor isolated from exhaust airstream.

E. Accessories:
1. Disconnect Switch: Non-fusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
2. Bird Screens: Removable, 1/2-inch mesh, aluminum, or brass wire.
3. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
4. Variable-Speed Controller for Direct Drive Fans: Solid-state control to reduce speed from 100 percent to less than 50 percent.
5. Additional accessories as noted on the exhaust fan equipment schedules.

F. Roof Curbs: Roof curb shall be Trapezoidal fixed cell standing seam roof sloped seismic roof curb by Thybar or approved equal. Coordinate final roof type with Architect and Structural contractor.
1. Overall Height: 18 inches.

2. Sound Curb: Curb with sound-absorbing insulation matrix.
3. Pitch Mounting: Manufacture curb for roof slope.
4. Metal Liner: Galvanized steel.
5. Hinged Subbase: Galvanized steel hinged arrangement permitting service and maintenance.
6. Mounting Pedestal: Galvanized steel with removable access panel.

2.3 CEILING-MOUNTING VENTILATORS

A. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.

B. Housing: Steel, lined with acoustical insulation.

C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

D. Grille: Painted Steel, louvered grille with flange on intake and thumbscrew attachment to fan housing.

E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

F. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent.
2. Manufacturer's standard roof jack or wall cap, and transition fittings.
3. Isolation: Rubber-in-shear vibration isolators.
4. Additional accessories as noted on the exhaust fan equipment schedules.

2.4 MOTORS

A. Refer to Division 15 Section "Motors" for general requirements for factory-installed motors.

B. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B.

C. Enclosure Type: TEFC.

2.5 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.

C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

D. Support suspended units from structure using threaded steel rods and spring hangers with vertical-limit stops having a static deflection of 1 inch. Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

E. Install units with clearances for service and maintenance.

F. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. Verify that shipping, blocking, and bracing are removed.
   2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
   3. Verify that cleaning and adjusting are complete.
   4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
   5. Adjust belt tension.
   6. Adjust damper linkages for proper damper operation.
   7. Verify lubrication for bearings and other moving parts.
   8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
   9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
   10. Shut unit down and reconnect automatic temperature-control operators.
   11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION 233423

SECTION 233616 – VARIABLE AIR VOLUME SINGLE DUCT TERMINAL UNITS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Single Duct Terminal Units.

B. Integral heating coils.

1. Electric resistance.

1.02 RELATED SECTIONS

A. Section 233113 – Metal Ducts.

B. Section 233300 – Air Duct Accessories .

C. Section 233500 – Common Work Requirements for HVAC.

D. Section 233713 – Diffusers, Registers and Grilles.

E. Section 260500 – Common Work Results for Electrical – Materials and Methods.

1.03 REFERENCES

A. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

B. UL 181 - Factory-Made Air Ducts and Connectors.

C. NFPA 70 - Electric Duct Heaters.

D. UL 1995, Heating and Cooling Equipment.

E. CUL C22.2 No. 236, Heating and Cooling Equipment.

F. AHRI 880 - Air-Conditioning and Refrigeration Institute Standard Rating Conditions for Air Terminals.

G. AHRI 885 - Air-Conditioning, Heating and Refrigeration Institute Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.

H. ASTM A 527 (Steel Sheet, Zinc Coated Galvanized).

1.04 SUBMITTALS

A. Submit shop drawings and product data sheets indicating configuration, general assembly, and materials used in fabrication.

B. Submit product performance data indicating design air flow, minimum airflow, minimum static pressure drop.

C. Submit sound power in accordance with AHRI Standard 880 2017 and noise criteria (NC) values, in accordance with AHRI Standard 885 2008, for radiated and discharge paths.

    1. Unit maximum sound power levels in each octave band with 0.750 in H2O inlet pressure and specified design discharge and air volume scheduled shall not exceed the scheduled radiated and discharge sound power levels for each respective unit. No credit or reduction shall in any way be considered for room, plenum, ceiling, sound attenuator, and/or similar item effects.

D. Submit unit casing and damper air leakage rates in accordance with ASHRAE Standard 130.

    1. Unit casing and inlet air leakage levels at 1.000 in H2O inlet pressure shall not exceed the scheduled air leakage levels for each respective unit. No credit or increased unit casing air leakage shall in any way be considered for optional items.

E. Submit BACnet Protocol Implementation Conformance Statement (PICS), including:

    1. Standardization Device Profile (Annex L)
    2. Interoperability Building Blocks (Annex K)
    3. Segmentation Capability
    4. Object types: descriptions and configuration.
    5. Data Link Layer options
    6. Character sets

F. Submit BACnet integration guide detailing all the data points available for integration. At a minimum, the BACnet guide shall include:

1. Tables showing object data points and configurations. Tables shall provide Object Type, Object Name, Units of Measure, Low Limit, High Limit, and Description.
2. Tables shall indicate where each point is used (Flow Tracking, Vent Flow Control (with and without heat), Space Temp control (with and without heat)
3. Alarm Objects
4. Object Data Points and Diagnostic Data Points (for each data point)
5. BACnet Type (AI, AV, BV, MI, MV, etc) (for each data point)
6. BACnet Property Values (for each data point)
7. Alarm Objects and their Notification class

G. Submit installation, operation and maintenance documentation.

H. Failure to submit any of these items or an impartial submittal will result in submittal rejection. Piece meal submittals are not acceptable.

1.05 QUALIFICATIONS

A. Manufacturer: The company manufacturing the products specified in this section shall have a minimum of ten years experience producing products of this type.

1.06 SYSTEM RESPONSIBILITY

A. The contractor shall be responsible for any and all costs associated with any and all changes resulting from the use of a supplier other than the one used as "basis of design".

B. The duct system is computer designed for air balance and noise control using the performance data of the listed manufacturer. Substituting another VAV terminal unit manufacturer may require changes in the system design.

These changes may include, but are not limited to, changes in ductwork size or layout, fittings, controls, building structure and piping. The installing contractor, upon substituting an approved alternate, must submit a computerized duct design showing system pressure requirements and acoustic data for the complete duct layout.

C. The VAV system, including terminal units, direct digital controls and ATC/Building Management System shall be furnished by a single manufacturer who shall be responsible for system performance. If the terminals unit supplier is different from the control system supplier, then one of the two suppliers must bear sole responsibility for proper system performance. The supplier bearing responsibility shall be identified at the time of submittal.

1.07 WARRANTY

A. Provide manufacturer's part and labor warranty for two years from unit start-up or thirty months from unit shipment, whichever is shorter.

B. Warranty shall be provided by the manufacturer. 3rd party warranties (contractor bond, AIG, self-performance, etc) are NOT acceptable and will be rejected.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. GENERAL

1. Manufacturer shall participate in the AHRI Certification program. Unit performance data shall be rated in accordance with AHRI Standard 880. The manufacturer shall display the AHRI Symbol on all units.

B. Specified Manufacturers

1. Trane

2. Environmental Technologies Inc.
3. Titus

C. Rebranding and OEM (original equipment manufacturer) agreements: Units re-branded by others units are NOT acceptable and will be rejected. Letters from OEM stating that re-branded units are “equal” shall be rejected.

2.02 MANUFACTURED MODELS

A. Single duct terminal units.
1. Ceiling mounted primary air control terminal units for connection to a single 5 in. w.g. maximum pressure duct of a central air distribution system. Terminals units may be provided with controls and integral heating coils.
2. Identify each terminal unit with clearly marked identification label and airflow indicator. Label shall include unit nominal air flow, maximum factory-set air flow, minimum factory-set air flow, and coil type.

2.03 FABRICATION

A. Casings: Units shall be completely factory-assembled, manufactured of corrosion protected steel, and fabricated with a minimum of 18-gauge metal on the high pressure (inlet) side of the terminal unit damper and 22-gauge metal on the low pressure (outlet) side and unit casing.

B. Insulation: Double-wall - The interior surface of unit casing acoustically and thermally lined with a minimum of 1-inch, 1.0 lb/ft3 (25.4 mm, 16.0 kg/m3) composite density glass fiber with a high-density facing. Minimum insulation R-Value of 3.85. Insulation shall meet NFPA-90A and UL 181 requirements. The insulation is covered by an interior metal liner made of 26 gauge galvanized steel. The interior metal liner shall isolate the fiberglass insulation from the airstream and allow for cleaning of the terminal unit

interior surfaces. All cut edges of the insulation are covered by metal flanges. There are no exposed edges of insulation (complete metal encapsulation). All wire penetrations through the interior metal liner shall be covered by grommets.

C. Assembly: Primary air control damper, airflow sensor, controls and optional heating coil in single assembly.

D. Rectangular Supply Air Outlet Connections: Rectangular outlet connections for units without optional heating coils on the outlet of the terminal unit shall be flange type. Rectangular outlet connections for units with optional heating coils on the outlet of the terminal unit shall be slip and drive type.

2.04 PRIMARY AIR CONTROL DAMPER ASSEMBLY

A. Construct damper assembly from a minimum of 18 gauge galvanized steel on the primary air side of the terminal. Blade shall incorporate a full closed cell damper seal to minimize leakage. Damper blade shall be a minimum of 0.10 in. thickness. Maximum damper leak rate shall not exceed scheduled air leakage rate.

B. Locate primary air control damper assembly inside unit casing. Construct the damper assembly from extruded aluminum and/or a minimum 22 gauge galvanized steel components. Maximum damper leak rate shall not exceed scheduled air leakage rate at scheduled inlet pressure.

C. Damper assembly shall be constructed self-lubricating bearings and contain a mechanical stop.

D. Primary Damper Shaft shall have a position indicator stamped on the end of the shaft to identify damper position without disassembly of duct, unit casing, or removal of the control box cover.

E. Provide damper assembly with integral flow sensor. Flow sensor shall be provided regardless of control type. Flow sensor shall be a 16-point (minimum 8-points on high pressure side and 8-points on low pressure side),

averaging ring or cross type. Bar or single point sensing type is not acceptable. Damper assembly shall be capable of maintaining airflow to within +/- 5 percent of rated unit airflow setpoint with 1.5 duct diameters straight duct upstream from the unit.

F. Flow sensor transducer shall not be integral to the unit controller.

G. Flow coefficient calibration data shall be provided for each terminal unit at or near the unit inlet.

H. Integral flow sensor pressure transducer shall be pressure tested, with air, prior field installation.

I. Terminal unit manufacturer shall provide and factory install DDC damper actuator direct coupled to primary air control damper assembly shaft. Damper actuator shall be a 24-VAC floating-point spring return with a constant drive rate independent of load a rated and a rated torque of 62 in.-lb.

2.05 HEATING COILS

A. Electric Resistance Heating Coil: Coil shall be factory installed and wired and shall be constructed of open-wire type C nickel chromium alloy. Coils shall be provided with primary and secondary over-temperature protection located properly to allow jobsite determination of handing without relocation. Coils shall be constructed for single point power connection. Controls shall consist of an integral control box which includes a 24 VAC transformer and silicon-controlled rectifier (SCR). Electric heat coil shall be fully removable independent of electric heater or controls components. All electric heater and controls components shall be installed independent of handing to allow jobsite determination of handing.

1. Electric heat coil shall be furnished with an airflow switch, where airflow is proven in the wake of the airflow metering device, to disable the coil upon a low flow condition.

2. Disconnect switch - Provide a door interlocking rotary switch to disconnect power to the unit when the coil control panel is opened.
3. Power Line Fuse - Provide electric heat coils with integral power line fusing installed in the coil control box to prevent overcurrent damage to the coil.

B. Capacity: Provide coils in capacities as scheduled on the drawings.

2.06 WIRING

A. Factory install and wire terminal unit. Install electrical components in control box with removable cover. Incorporate single point electrical connection to power source.

B. Disconnect switch - Provide terminal units with a factory installed and wired switch to disconnect power to the unit.

C. Power Line Fuse - Provide single and dual duct terminal units with integral power line fusing installed in the control box to prevent overcurrent damage to the unit.

D. Control Transformer - Provide terminal units with a factory installed and wired 24 VAC transformer to provide control voltage power to the unit.

2.07 DIRECT DIGITAL VAV CONTROLS

A. VARIABLE AIR VOLUME (VAV) TERMINAL UNIT CONTROL.

1. Terminal unit manufacturer shall mount a 10k ohm type II thermistor temperature sensor in the supply air path downstream of heating coil, if applicable, within the terminal unit. Sensor shall be wired to the ATC by the terminal unit manufacturer utilizing plenum rated cabling or conduit.

B. DDC Controls, actuator and factory costs to mount, calibrate and test the system shall be the responsibility of Section 159xx Building Management System Contractor.

C. Terminal unit manufacturer shall provide price for factory mounting, continuity check, calibrating, and testing of direct digital controls to the ATC contractor. Field mounted DDC controls are not acceptable.

D. Each Air Terminal shown on the plans shall include a factory mounted and wired unit controller. Each unit controller shall include a microprocessor based controller and shall be an integral part of the equipment. The unit controller shall control each function of its associated terminal. All application software shall be resident in the unit controller's memory and shall be factory pretested and preconfigured. Each unit controller shall be programmed based on inlet size with tested proven airflow coefficients provided by terminal unit manufacturer. Unit controller shall be programmed with airflow set points based on scheduled performance: minimum ventilation airflow, minimum heating airflow, maximum airflow(s).

E. The unit controller shall be fully tested. All features shall be tested including fan and reheat stage energization, air valve modulation, and inputs and outputs. Each terminal unit shall bear a label containing the following information or Building Management System Contractor must provide a report containing the following information:

1. Unit serial number and tag
2. Minimum and maximum fan airflow
3. Minimum and maximum primary airflow
4. Test equipment identifier and test complete date
5. Identifier of control algorithm loaded

F. Terminal unit manufacturer or Building Management System Contractor shall provide test report for each unit upon request identifying tests executed and passed.

2.08 TESTING / VERIFICATION

A. Maximum Casing Leakage: 1 percent of nominal air flow at 0.5 in wg inlet static pressure.

B. Maximum Damper Leakage: 1 percent of design air flow at 4 in wg inlet static pressure.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.02 ADJUSTING

A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design air flow to 25 percent nominal air flow for cooling only units and 30 percent for units with heating coils.

END OF SECTION 233616

SECTION 233713 - DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

B. Related Sections:

1. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.
2. Division 23 Section “Testing, Adjusting, and Balancing for HVAC” for balancing 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

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.

B. Manufacturers:
1. Titus
2. Tuttle & Bailey
3. Price (Basis of Design)
4. Krueger

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

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

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve

design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as 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. Provide an additional five diffusers/registers of each type and size used on the project to accommodate ductwork revisions required to resolve interferences or as directed by the Engineer.

D. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 CLEANING

A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 233713

SECTION 237413 - MZVAV & SZVAV PACKAGED ROOFTOP AIR CONDITIONING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Package roof top unit.

B. Marine Coatings.

C. Heat exchanger.

D. Refrigeration components.

E. Refrigerant Detection System

F. Unit operating controls.

G. Electrical power connections.

H. Operation and maintenance service.

1.02 RELATED SECTIONS

A. Section 230513 – Common Motor Requirements for HVAC Equipment.

B. Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment.

C. Section 230700 - HVAC Insulation.

D. Section 233113 – Metal Ducts.

E. Section 230900 – Building Automation System.

F. Section 260500 – Common Work Results for Electrical – Materials.

G. Section 260519 – Conductors and Cables.

H. Section 260533 – Raceways and Boxes.

1.03 REFERENCES

A. NFPA 90 A & B - Installation of Air Conditioning and Ventilation Systems and Installation of Warm Air Heating and Air Conditioning Systems.

B. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.

C. AHRI 340/360- 2015 - Commercial and Industrial Unitary Air Conditioning Equipment testing and rating standard.

D. ANSI/ASHRAE 37 - Testing Unitary Air Conditioning and Heat Pump Equipment.

E. ANSI/ASHRAE/IESNA 90.1-1999 - Energy Standard for New Buildings Except Low-Rise Residential Buildings.

F. ANSI Z21.47/UL1995 - Unitary Air Conditioning Standard for safety requirements and testing requirements for commercial warm air furnaces.

G. AHRI 370 - Sound Rating of Large Outdoor Refrigerating and Air Conditioning Equipment.

H. ANSI/NFPA 70- National Electric Code.

I. UL STANDARD 60335-2-40.

1.04 SUBMITTALS

A. Submit unit performance data including: capacity, nominal and operating performance. Performance shall be per the conditions scheduled on the mechanical drawings.

1. For RTU-1: Submit minimum airflows for MZVAV units. Include:

a. Minimum Airflow – Fan only mode

b. Minimum Airflow – Cooling mode

c. Minimum Airflow – Heating mode

2. For RTU-2: Submit hot gas reheat performance at 70F Ambient and a mixed air temperature of 73F / 64F. (or as scheduled on the mechanical drawings).

B. Submit Mechanical Specifications for unit and accessories describing construction, components and options.

C. Submit cutsheet/specification on the refrigerant monitor used in the refrigerant leak detection system.

1. Submit refrigerant mitigation sequence.

D. Submit marine coating specification and scope of application.

E. Submit shop drawings indicating overall dimensions as well as installation, operation and services clearances. Indicate lift points and recommendations and center of gravity. Indicate unit shipping, installation and operating weights including dimensions.

F. Submit data on electrical requirements and connection points. Include recommended wire and fuse sizes or MCA, sequence of operation, safety and start-up instructions.

G. Submit BTL listing certification for rooftop unit controller.

1. If the BTL certification is not provided by the roof top unit manufacturer, contractor shall have the unit tested for BTL compliance at BTL laboratories, MBS, TUV SUD, or KTC Institute. Upon final testing, submit BTL certification prior to RTU transportation to the jobsite. Rooftop unit cannot be accepted on site until BTL certification is provided.

H. Submit BACnet integration guide detailing all the data points available for integration. At a minimum, the BACnet guide shall include:

1. BACnet Protocol Implementation Conformance Statement (PICS), including:
    a. Standardization Device Profile (Annex L)
    b. Interoperability Building Blocks (Annex K)
    c. Segmentation Capability
    d. Object types: descriptions and configuration.
    e. Data Link Layer options
    f. Character sets
2. Tables showing object data points and configurations. Tables shall provide Object Type, Object Name, Units of Measure, Low Limit, High Limit, and Description.
3. Tables shall indicate where each point is used (Flow Tracking, Vent Flow Control (with and without heat), Space Temp control (with and without heat)
4. Alarm Objects
5. Object Data Points and Diagnostic Data Points (for each data point)
6. BACnet Type (AI, AV, BV, MI, MV, etc) (for each data point)
7. BACnet Property Values (for each data point)
8. Baud Rate and Supported Character Sets
9. Inputs With Alarming Capabilities
10. Must include BACnet points for Refrigerant Detection System. A simple “alarm” is not sufficient. Provide BACnet points for:
    a. Refrigerant Leak Detection System Input - The Active state is maintained for the duration of the refrigerant detection system alarm state.
    b. Refrigerant Mitigation Active - This point indicates whether the Symbio

controller is in a refrigerant mitigation state. It can be utilized for coordinating actions with other building systems.

c. Diagnostic: Refrigerant Concentration Sensor - Active when Refrigerant Leak Sensor is in the alarm state. Resets to inactive when the Refrigerant Leak Sensor alarm has reset; refrigerant concentration has reduced below the lower concentration threshold.

I. For RTU-1: Submit sequence of operation detailing Multi Zone VAV operation. Document that the units will operate at 25% of scheduled airflow during both cooling mode and heating mode.

J. For RTU-2: Submit sequence of operation detailing Single Zone VAV operation. Document that the units will operate at 57% of scheduled airflow during cooling mode.

K. Failure to submit any of these items or an impartial submittal will result in submittal rejection. Piece meal submittals are not acceptable.

1.05 DELIVERY, STORAGE and HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Protect units from physical damage. Leave factory shipping covers in place until installation.

1.06 WARRANTY

A. Provide whole unit warranty (parts and labor) for five years from start-up or 66 months from shipment, whichever occurs first.

B. Warranty shall be provided by the manufacturer. 3rd party warranties (contractor bond, AIG, self-performance, etc.) are NOT acceptable and will be rejected.

1.07 MANUFACTURER'S MAINTENANCE SERVICE

A. Provide written service contract, executed by manufacturer's approved representative, agreeing to provide scheduled maintenance in the warranty period.

1. Service shall cover the first year (year 1) and be in conjunction with the 5-year parts & labor warranty.

2. Service shall include:

a. Annual maintenance inspection per unit

b. (4) Quarterly filter changes per unit

c. (2) cooling operating inspections per unit

d. (2) heating operating inspections per unit

3. Maintenance and inspections shall be supplied by the manufacturer's approved service representative. 3rd party service (contractor, AIG, self-performance, etc.) are NOT acceptable and will be rejected.

1.08 REGULATORY REQUIREMENTS

A. Unit shall conform to UL STANDARD 60335-2-40 for construction of packaged air conditioner (with A2L refrigerant) and shall have UL/CSA label affixed to rooftop package.

1. In the event the unit is not UL approved, the manufacturer must, at his expense, provide for a field inspection by a UL representative to verify conformance to UL standards. If necessary, contractor shall perform modifications to the unit to comply with UL, as directed by the UL representative, at no additional expense to the Owner.

B. Conform to Canadian Standards Association (CAN/CSA-2.3/CAN/CSA C22.2 #236) for construction of packaged air conditioner and attach CSA label to unit.

1. In the event the unit is not CSA approved, the manufacturer must, at his expense, provide for a field inspection by a CSA representative to verify conformance to CSA standards. If necessary, contractor shall perform modifications to the unit to comply with CSA, as directed by the CSA representative, at no additional expense to the Owner.

1.09 ENERGY EFFICIENCY

A. Provide units with equal to or greater than full load efficiency prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

B. Part load efficiency: Provide the SEER and IEER performance detailed on the schedules. Any substitution must meet or exceed this value for every unit under this specification.

PART 2 PRODUCTS

2.01 SUMMARY

A. The contractor shall furnish and install package rooftop unit(s) as shown and scheduled on the contract documents. The unit(s) shall be installed in accordance with

this specification and perform at the specified conditions as scheduled.

1. RTU-1 serves a VAV system, and must be able to provide cooling and heating down to 1150 cfm.

B. APPROVED MANUFACTURERS

1. Trane (Basis of design)
2. Valent
3. Deschamps

C. Rebranding and OEM (original equipment manufacturer) agreements: Units re-branded by others units are NOT acceptable and will be rejected. Letters from OEM stating that re-branded units are “equal” shall be rejected.

2.02 GENERAL UNIT DESCRIPTION

A. Unit(s) furnished and installed shall be combination gas heating/electric cooling packaged rooftop (s) as scheduled on contract documents and these specifications. Cooling capacity ratings shall be based on AHRI Standard 340/ 360. Unit(s) shall consist of insulated weather-tight casing with compressor(s), air-cooled condenser coil, condenser fans, evaporator coil, return-air filters, supply motors and unit controls, and gas-fired heating section.

B. Unit(s) shall be 100% factory run tested and fully charged with R-410A, or manufacturer shall supply an independent testing agency to field run test unit at job site.

C. Unit(s) shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.

D. Units shall be downflow airflow or horizontal airflow as manufactured.

E. Wiring internal to the unit shall be colored and numbered for identification.

F. Unit shall be field convertible from horizontal to vertical and shall allow mixed configurations.

1. Unit airflow configuration shall be as shown on the drawings. Units shall be either:

a. Vertical discharge thru unit base.

b. Horizontal discharge through side of unit.

c. Mixed Airflow (down and horizontal)

2. As a substitute for horizontal units, contractor may use a downflow unit with an elevated curb that has horizontal duct transitions. The curb shall be at least 42" tall to allow for proper duct sizing and snow loading. The contractor must provide the curb with:

   a. Elevated service platform, 4 feet in depth around entire perimeter.

   b. Guard rail around entire perimeter of service platform of at least 45 inches or complying with OSHA regulations.

   c. Steps allowing for unencumbered access to platform. Ladders are NOT allowed.

   d. Service disconnect located at step entrance at code compliant height.

   e. Entire assembly (including curb, service platform, railing, stair, etc) shall be seismically/wind rated for the building location.

   f. All impacts from using an elevated curb with platform (structural, concrete, electrical, mechanical, architectural, engineering) shall be borne solely by the installing contractor with no cost to the owner. Any structural impact must be evaluated by a New Jersey licensed structural engineer. Engineer shall provide signed and sealed drawings show that the impact has been addressed. Engineer's fees shall be borne solely by the installing contractor with no cost to the owner.

2.03 UNIT CASING

A. Cabinet: Galvanized steel, phosphatized, and finished with an air-dry paint coating with removable access panels. Structural members shall be 16 gauge with access doors and removable panels of minimum 20 gauge.

B. Units cabinet surface shall be tested 672 hours in salt spray test in compliance with ASTM B117.

C. Job site is located in a marine environment, and all heat rejection equipment located outdoors shall be provided with marine style coatings. These coatings shall be in addition to the standard paint provided by the manufacturer.

   1. Exterior Casing (all surfaces except for the condenser coil): All exterior casings shall be provided with a one-part polyurethane, metallic pigmented coating to provide additional protection of ASTM B117 – 15,000 hours no impact.

   2. All exterior casings shall be provided to with withstand Cyclic Salt Fog/UV Exposure ASTM D5894-21 testing standard – 10,000 hours no impact.

3. Colors, will be a silver-grey color and cannot be tinted.

4. Walls and Roof: containing a 51 percent solid by volume and applied at 200 square feet/gallon for a 4 dry mil thickness. Check and comply with manufacturer's recommended technical data sheets for adjustments or other requirements to compensate for porosity and other surface adjustments.

5. Steel Posts, trusses: The coating utilized shall be a one-part polyurethane metallic pigmented coating containing 51.3 percent solids by volume. Film thickness must be 4.0 mils dry film thickness. Comply with manufacturer's recommended technical data for other requirements.

6. All materials are to be lead and chromate free.

D. Cabinet construction shall allow for all service/ maintenance from one side of the unit.

E. Cabinet top cover shall be one piece construction or where seams exits, it shall be double-hemmed and gasket-sealed.

F. Hinged Access Panels: Water- and air-tight panels with handles shall provide access to filters, heating section, return air fan section, supply air fan section, evaporator coil section, and unit control section.

1. The following sections shall have hinged access: Filter/Evaporator Access Door and the Compressor/Control Access Door.

G. Provide ½ inch foil faced, fire retardant permanent, odorless glass fiber material. All edges captured so that there is no insulation exposed in the air Stream.

H. All panels in the evaporator section of the unit have cleanable foil-faced insulation. All edges are either captured or sealed to ensure no insulation fibers get into the airstream.

I. Provide openings either on side of unit or thru the base for power, control and gas connections.

J. The base of the unit shall have provisions for forklift and crane lifting.

2.04 FILTRATION

A. Provide 2" MERV 13 filters.

B. Provide dirty filter switch to alert the BAS to a dirty filter condition.

2.05 FANS AND MOTORS

A. Provide evaporator fan section with forward curved, double width, double inlet, centrifugal type fan.

B. Provide self-aligning, grease lubricated, ball or sleeve bearings with permanent lubrication.

C. Supply fans shall be belt driven with adjustable motor sheaves.

D. Indoor fan shall be direct drive and shall have an electronically commutated motor (ECM). Fan speed adjustments shall be made either on the unit's user interface or on a mobile app. Outdoor and Indoor Fan shall be permanently lubricated and have internal thermal overload protection.

E. Outdoor fans shall be direct drive, statically and dynamically balanced, draw through in the vertical discharge position.

F. Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

G. All units have variable speed operation. All motors shall be thermally protected.

1. Provide units with variable speed, direct drive motors. All motors shall be thermally protected. Motors shall be Electronically Commutated Motors (ECM).

2. Where ECM's are not available, supply TEFC motor and Variable Frequency Drives.

3. Indoor fans shall be driven either by ECM control or VFD control. No exceptions.

2.06 SINGLE ZONE VARIABLE AIR VOLUME (SZVAV) (as per the schedule)

A. The unit shall control the discharge air temperature to a varying discharge air temperature setpoint by use of a zone sensor.

B. Provide all necessary controls to operate a rooftop unit based on maintaining two temperature setpoints: discharge air and zone. During one zone vav cooling, the unit will maintain zone cooling setpoint by modulating the supply fan speed to meet zone load demand; and the unit will maintain discharge temperature to the discharge cooling setpoint by modulating economizer if available and staging dx cooling. Airflow shall be reduced to 57% in cooling mode.

2.07 MULTIZONE VARIABLE AIR VOLUME (MZVAV) (as per the schedule)

A. A multiple-zone VAV (MZVAV) system consists of a packaged rooftop unit that serves several individually controlled zones. Each zone is equipped with a VAV terminal unit that varies the quantity of air delivered to maintain the desired temperature in that zone. The rooftop unit controller varies the speed of the indoor fan to maintain the static pressure in the supply ductwork at a setpoint, ensuring all zones

receive the necessary quantity of air. In addition, cooling capacity is cycled to maintain the supply air temperature at the desired setpoint. Unit shall turn down to 50% airflow and by "riding the static curve", get to 25% airflow without stall.

B. Provide all necessary controls to operate a rooftop unit based on serving a multizone VAV system. A multiple-zone VAV (MZVAV) system consists of a packaged rooftop unit that serves several individually controlled zones. Each zone shall be equipped with a VAV terminal unit that varies the quantity of air delivered to maintain the desired temperature in that zone. The rooftop unit controller shall vary the speed of the indoor fan to maintain the static pressure in the supply ductwork at a setpoint, ensuring that all zones receive the necessary quantity of air. In addition, cooling capacity shall be cycled to maintain the supply air temperature at the desired setpoint.

2.08 STAINLESS STEEL GAS FIRED HEATING SECTION WITH STAGED OR MODULATING CONTROL (AS SCHEDULED)

A. Stainless steel heat exchanger with 409 stainless steel tubes and 439 stainless steel burners shall be provided.

B. The heating shall be either:

1. 2-stage (where scheduled.)

2. Modulating (where scheduled). Provide modulate the firing rate (10:1 for Nat. gas, 6:1 for LP) based on space temperature or discharge air temperature when used for supply air tempering. The heating section shall have a progressive tubular heat exchanger with corrosion-resistant aluminized steel tubes and burners as standard on all models. Stainless steel heat exchanger with 409 stainless steel tubes and 439 stainless steel burners shall be optional. Induced draft combustion blower shall be used to pull the combustion products through the firing tubes. Heater shall use a direct spark ignition (DSI) system.

   The gas heater shall be able to operate (provide heating) in VAV mode down to 1150 cfm.

   a. In lieu of a factory supplied heat exchanger that cannot meet these airflow requirements, the installing contractor shall:

      (i) Contract with Fisen USA, Fingerlakes Environmental, MJC manufacturing, or equal to provide a custom heating system that meets these operating requirements.

      (ii) Have the modified units tested to UL standards by UL Laboratories, Interek Laboratories, or MetLabs.

(iii) Obtain extended warranty coverage (to meet the requirements set forth in this spec) supplied by the heat exchanger manufacturer, AIG, or Trinity Warranties.

(iv) Bear all costs for the substitution, including lab testing and warranty coverage, with NO costs to the owner.

C. Completely assembled and factory installed heating system shall be integral to unit, UL or CSA approved specifically for outdoor applications for use downstream from refrigerant cooling coils. Threaded connection with plug or cap provided.

D. Heating section shall be factory run tested prior to shipment.

E. Induced draft combustion blower shall be used to pull the combustion products through the firing tubes. System shall use direct spark ignition (DSI).

F. After three unsuccessful ignition attempts, entire heating system shall be locked out until manually reset at the thermostat/zone sensor.

G. Induced draft blower to pull the gas mixture through the burner tubes.

H. Compact cabinet features a tubular heat exchanger in low, medium and high heat capacities. Corrosion-resistant aluminized steel tubes and burners are standard on all models.

I. Limit controls: High temperature limit controls will shut off gas flow in the event of excessive temperatures resulting from restricted indoor airflow or loss of indoor airflow.

2.09 OUTDOOR AIR SECTION

A. Provide field installed economizer.

B. Provide field installed automatic differential enthalpy control.

C. Provide adjustable minimum position control located in the economizer section of the unit.

D. Provide spring return motor for outside air damper closure during unit shutdown or power interruption.

E. Provide CO2 based demand control ventilation.

F. Without the need for an outdoor air measuring station, the unit shall manage the fan speed to according to the outdoor air damper position to prevent over ventilating.

2.10 EXHAUST/RETURN SECTION

A. Provide a factory supplied, field installed power exhaust assembly that shall assist the barometric relief damper in the economizer in relieving building pressurization.

B. All installation and wiring shall be the responsibility of the installing contractor.

C. Horizontal configuration: Exhaust fan shall be installed in the return ductwork by the installing contractor. Installing contractor shall connect all wires required for the accessory installation.

2.11 REFRIGERATION SYSTEM (STAGED AND VARIABLE SPEED)

A. Refrigeration system shall be provided with a refrigerant that has a Global Warming Potential of 500 or less.

1. Basis of design is R-454B.
2. Other refrigerants below 500 GWP shall be permitted with an PE stamped calculation showing compliance with ASHRAE 15. Specifically the EDVC calculation shall be provided in order to comply with code. PE stamp shall be current and licensed in New Jersey.

B. Compressor(s): Provide scroll compressor with direct drive operating at 3600 rpm. Integral centrifugal oil pump. Provide suction gas cooled motor with winding temperature limits and compressor overloads.

C. Compressor(s): Provide direct drive, hermetic type, scroll compressor with centrifugal type oil pump. Motor shall be suction gas cooled and have internal spring isolation. Compressors shall include crankcase heaters, internal pressure relief, temperature and current sensitive overloads.

D. Unit shall operate at full cooling capacity down at outdoor temperatures to zero F. The installing contractor shall provide proper installation and operation of low ambient accessory.

E. Provide each unit with two refrigerant circuit(s) factory-supplied completely piped with liquid line filter-drier, suction and liquid line pressure ports.

F. Where staged compressors are scheduled:

1. Units 5 tons and below: Provide (2) stages of DX cooling.
2. Units 6 tons to 17.5 tons: Provide (3) stages of DX cooling. Unloading shall be down to 30% of the unit’s capacity.
3. Units 20 tons to 25 tons: Provide (4) stages of DX cooling. Unloading shall be down to 30% of the unit’s capacity.

a. In lieu of 3 or 4 stages, a variable speed compressor may be utilized. Single compressors and digital compressors are NOT allowed.

G. Where variable speed compressors are scheduled:

1. Provide variable speed compressors, similar to Trane® eFlex or Danfoss VZH

2. All units shall have a variable speed compressor matched with a variable frequency drive that modulated the speed of the compressor motor. Compressor motors shall include permanent magnet motors with voltage utilization range of plus or minus 10 percent of unit nameplate voltage. For 12.5 - 17.5Ton - The variable speed compressor shall be capable of speed modulation from 15Hz to a maximum of 75 Hz. The minimum unit capacity shall be 4-7%. The compressor motor shall be a permanent magnet type. Each variable speed compressor shall be matched with a specially designed, refrigerant-cooled, variable frequency drive which modulates the speed of the compressor motor and provides several compressor protection functions.

3. Variable speed compressors shall be provided to allow for active cooling at the minimum airflows detailed on the schedule.

4. In lieu of a factory supplied compressors that cannot meet these requirements, the installing contractor shall:

a. Contract with Fisen USA, Fingerlakes Environmental, MJC manufacturing, or equal to provide a custom refrigeration system that meets these variable speed compressor requirements.

b. Have the modified units tested to UL standards by UL Laboratories, Interek Laboratories, or MetLabs.

c. Obtain extended warranty coverage (to meet the requirements set forth in this spec) supplied by the compressor manufacturer, AIG, or Trinity Warranties.

d. Bear all costs for the substitution, including lab testing and warranty coverage, with NO costs to the owner.

H. Provide Refrigerant Leak Detection System for any units with more than 4 lbs of charge in a circuit, compliant to UL 60335-2-40..

1. Provide Factory Installed Refrigerant Leak Detection System.
    i. Unit shall be furnished by the manufacturer with a factory installed refrigerant leak detection system (RLDS) compliant to UL 60335-2-40.
2. As an alternate to factory installation, the installing contractor may:
    i. Supply and field install the RLDS.
    ii. Prior to acceptance, the installing contractor shall have each unit field certified by a UL inspector for compliance with UL STANDARD 60335-2-40. UL inspectors can be obtained from UL Laboratories, Intertek (ETL), or MetLabs. All costs associated with field certifications shall be borne by the installing contractor and will result in no charge to the contract. Field certification will not be cause for a delay claim.
3. The leak detection system shall consist of one or more refrigerant detection sensors.
4. Units provided with factory installed leak detectors shall have BACnet points to communicate to BAS. Manufacturer shall integrate the Leak detection system into the DDC controller and provide the following points to the BAS via open protocol communications (BACnet, Lontalk, Modbus, etc):
    A. Refrigerant Leak Detection System Input - The Active state is maintained for the duration of the refrigerant detection system alarm state.
    B. Refrigerant Mitigation Active - This point indicates whether the Symbio controller is in a refrigerant mitigation state. It can be utilized for coordinating actions with other building systems.
    C. Diagnostic: Refrigerant Concentration Sensor - Active when Refrigerant Leak Sensor is in the alarm state. Resets to inactive when the Refrigerant Leak Sensor alarm has reset; refrigerant concentration has reduced below the lower concentration threshold.
5. When the system detects a leak, the unit controller shall initiate the following mitigation actions.
    A. When the refrigerant detection system is in a normal state, the equipment

provides normal heating, cooling, and ventilation.

B. The refrigerant sensor creates an alarm signal when the sensed refrigerant concentration has exceeded the refrigerant concentration alarm threshold. The alarm threshold is a non-adjustable preset value. Refrigerant concentration is read and reported from the leak detector.

C. While the refrigerant detection system is in an alarm state, the equipment is required to mitigate the alarm condition for a minimum of 5 minutes after the refrigerant detection system has reset to a normal state.

D. In the event the control system detects the refrigerant sensor has failed, become disconnected or unpowered; controls will respond with a diagnostic and mitigation becomes active. The unit shall operate to provide mitigation actions for the duration of the sensor failure mode. The supply fan will operate continuously, and all compressor operation is disabled. In heating modes of operation, non- compressor heating and ventilation are allowed to maintain space comfort. Economizer cooling operation is also allowed.

2.12 EVAPORATOR COIL

A. Provide configured aluminum fin surface mechanically bonded to copper tubing coil.

B. Provide an independent expansion device for each refrigeration circuit. Factory pressure test at 450 psig and leak test at 200 psig.

C. Provide drain pan for base of evaporator coil constructed of stainless steel with external connections. PVC or galvanized not acceptable.

D. Provide coil frost protection (Frostat).

1. Frostat shall open to prevent freezing temperatures on the evaporator coil.

2. Temperature will need to rise to 50°F before closing.

E. Job site is located in a marine environment, and all heat rejection equipment located outdoors shall be provided with marine style coatings. These coatings shall be in addition to the standard coating provided by the manufacturer. Provide evaporator coils with salt spray resistant coating.

1. Evaporator coils shall be provided with siloxane clear coatings to provide additional corrosion resistance that shall withstand ASTM B117 Salt spray test for 23,000 Hours and ASTM G85 A2 cyclic Acidified salt for test for

2,400 hours. This coating shall be added after coil construction covering all tubes , headers and fin edges, therefore providing optimum protection in more corrosive environments

2. Surface Treatments shall be ambient air temperature cured inorganic film structures.

3. Surface Treatments shall not act as insulator barriers, to the substrate, which would inhibit or degrade heat transfer coefficients.

4. Surface Treatments shall adhere to substrates by direct atom-to-atom covalent bonding methods.

5. Surface Treatments shall produce a dry film thickness no greater than 6 microns.

6. Surface Treatments shall have passed ASTM G-21, with a zero (0) microbial spore growth development rating. The standard ASTM G-21 test must have been conducted by an accredited, third party, independent laboratory.

7. Corrosion protection = ASTM B117 – 23,000 hours no impact

8. Mold = ASTM G21 - 28 days - No colonization

2.13 DEHUMIDIFICATION / HOT GAS REHEAT (WHERE SCHEDULED)

A. The unit shall be provided with a dehumidification package that utilizes hot gas reheat.

1. Control shall be modulating.

2. Submitted performance shall be based on 70F ambient and a mixed air condition of 73F/64F.

B. The unit shall be equipped with internally finned, 5/16" copper tubes mechanically bonded to configured aluminum plate fins. The coil shall be 2 row with a minimum of 16 fins per inch. Coil shall be installed downstream of the DX cooling coil.

C. Dehumidification shall be achieved by routing hot refrigerant gas from the discharge line of the compressor through the reheat coil.

D. The unit control shall determine the inside and outside dew points based on air temperature and relative humidity and shall initiate dehumidification if the dew point is above the minimum setting. If the space temperature falls 3 degrees below the cooling set point, dehumidification shall terminate.

E. HGRH shall be available in both vertical and horizontal airflow applications.

2.14 CONDENSER SECTION

A. Provide vertical discharge, direct drive fans with aluminum blades. Fans shall be statically balanced. Motors shall be permanently lubricated, with integral thermal overload protection in a weather tight casing.

B. Low ambient operation: Provide Evaporator Defrost Control (EDC) to provide low ambient cooling, down to 0º F. At this temperature, equipment will provide approximately 60% of the mechanical cooling capacity. When accumulated compressor run time reaches approximately 10 minutes, an evaporator defrost cycle is initiated.

C. Coil guards shall be shipped on unit.

D. Job site is located in a marine environment, and all heat rejection equipment located outdoors shall be provided with marine style coatings. These coatings shall be in addition to the standard paint provided by the manufacturer. Provide condenser coils with salt spray resistant coating.

1. Condenser coils shall be provided with siloxane clear coatings to provide additional corrosion resistance that shall withstand ASTM B117 Salt spray test for 23,000 Hours and ASTM G85 A2 cyclic Acidified salt for test for 2,400 hours. This coating shall be added after coil construction covering all tubes , headers and fin edges, therefore providing optimum protection in more corrosive environments

2. Surface Treatments shall be ambient air temperature cured inorganic film structures.

3. Surface Treatments shall not act as insulator barriers, to the substrate, which would inhibit or degrade heat transfer coefficients.

4. Surface Treatments shall adhere to substrates by direct atom-to-atom covalent bonding methods.

5. Surface Treatments shall produce a dry film thickness no greater than 6 microns.

6. Surface Treatments shall have passed ASTM G-21, with a zero (0) microbial spore growth development rating. The standard ASTM G-21 test must have been conducted by an accredited, third party, independent laboratory.

7. Corrosion protection = ASTM B117 – 23,000 hours no impact

8. Mold = ASTM G21 - 28 days - No colonization

2.15 OPERATING CONTROLS

A. Provide factory-wired roof top units with 24 volt control circuit with control transformers, contactor pressure lugs or terminal block for power wiring. Contractor to provide field-installed unit-mounted disconnect switch. Units shall have single point power connections. Field wiring of zone controls to be NEC Class II.

B. Provide microprocessor unit-mounted control which when used with an electronic zone sensor provides proportional integral room control. This UCM shall perform all unit functions by making all heating, cooling and ventilating decisions through resident software logic.

C. Unit control shall be capable of being set up, shall show status and alarms via Bluetooth connection to a mobile device. Mobile app shall report diagnostic information in plain language, failure codes not allowed.

D. Provide factory-installed indoor evaporator defrost control to prevent compressor slugging by interrupting compressor operation.

E. Provide an anti-cycle timing and minimum on/off between stages timing in the microprocessor.

F. Economizer Preferred Cooling (if supplied with economizer) - Compressor operation is integrated with economizer cycle to allow mechanical cooling when economizer is not adequate to satisfy zone requirements. Compressors are enabled if space temperature is recovering to cooling setpoint at a rate of less than 0.2 degrees per minute. Compressor low ambient lockout overrides this function.

G. Without the need for an outdoor air measuring station, the unit shall manage the fan speed to according to the outdoor air damper position to prevent over ventilating.

H. Clogged filter indication: Provide factory installed differential pressure switch to indicate filter replacement status. Differential pressure switch shall cause a contact closure to display a service indication and unit will continue to operate normally.

I. Discharge Air Temperature Sensing: Provide a factory installed discharge air temperature sensor. This sensor shall provide a status indicator readable through the BAS.

J. Demand-controlled ventilation (DCV). Provide demand control ventilation to responds to the actual demand (need) for ventilation by regulating the rate at which the HVAC system brings outdoor air into the building. A CO2 sensor shall measure the concentration (parts per million, ppm) of CO2 (Carbon Dioxide) in the air. As the CO2 concentration changes, the outside air damper shall modulates to meet the current ventilation needs of the zone.

K. Provide field installed, duct mounted CO2 sensor to monitor space occupancy levels within the building by measuring the parts per million of CO2 (Carbon Dioxide) in the air. As CO2 Levels increase, the economizer fresh air damper shall modulate to meet the co2 space ventilation requirements.

L. Condensate Drain Pan Overflow Switch: Provide a factory installed condensate overflow switch to shut the unit down in the event that the condensate drain line becomes clogged.

M. Refrigerant Leak Detection System provided in the refrigeration specification shall be connected to the RTU controller with information passed to the BAS through BACnet MS/TP.

2.16 BUILDING MANAGEMENT SYSTEM

A. Interface control module to Energy Management System to be furnished and mounted by rooftop unit manufacturer. Through this interface module, all Energy Management functions (specified in Energy Management Section) shall be performed. See Building Automation and Automatic Temperature Control System Specifications. The interface module with necessary controls and sensors shall all be factory mounted (not field mounted). If not furnished by rooftop unit manufacturer, this shall be furnished by Energy Management System Contractor for factory mounting by rooftop unit manufacturer in rooftop unit and rated for service up to 140 F. The only field connection to Energy Management System shall be a single communication link.

1. Provide open protocol BACnet interface.

2. BACnet communications interface shall allow the unit to communicate directly with a generic open protocol BACnet MS/TP Network Building Automation System Controls.

B. Control Functions: Include unit scheduling, occupied/unoccupied mode, start-up and coast-down modes, nighttime free-cool purge mode, demand limiting, night setback, discharge air set point adjustment, timed override and alarm shutdown.

C. Diagnostic Functions: Include supply fan status, , and a field supplied and installed sensor, to provide a dirty filter alarm, air flow failure, zone sensor failure, high temperature, outdoor air sensor failure, local cool/heat setpoint failure, compressor lockout, and if optional economizer is used; mi.

D. Provide capabilities for Boolean Processing and trend logs as well as "templated" reports and logs.

2.17 ELECTRICAL SYSTEM

A. An electrical service entrance shall be provided allowing electrical access for both control and main power connections inside the curb and through the base of the unit. Provide field installation of liquid-tight conduit.

1. Unit shall have 5kA SCCR rating from the factory.

B. Provide a factory installed 3-pole, molded case, disconnect switch with provisions for through the base electrical connection.

C. The unit shall be equipped with a phase monitor in the control box. The phase monitor shall protect against phase loss, imbalance and reversal of the line voltage.

D. Unit shall include a factory installed, 15A, powered convenience outlet. Outlet is to be powered from the line side of the disconnect or circuit breaker such that power is available when the circuit breaker is open. Outlet shall be GFCI type.

2.18 ACCESSORIES

A. Provide the units with:

1. Downflow configuration or horizontal configuration as shown on the drawings.
2. Marine coatings on the exterior casing, condenser coil, and evaporator.
3. 2,3, or 4 stages of DX cooling (as scheduled) using R-454B
4. Variable speed compressors (as scheduled) using R-454B
5. Refrigerant Leak Detection System (RLDS) and Mitigation sequence
6. Low ambient cooling down to 0F ambient.
7. Single Zone or MultiZone VAV configuration with discharge air control.
8. Modulating Hot gas reheat (part load dehumidification) for SZVAV operation.
9. Stainless steel condensate drain pan.
10. Modulating gas heat for discharge air tempering during VAV application.
11. Comparative enthalpy economizer.
12. CO2 based demand control ventilation.
13. Duct mounted CO2 sensor.
14. Discharge air sensor.
15. Dirty Filter Sensor.
16. Condensate Overflow sensor in the drain pan.

17. Power exhaust (duct mounted for horizontal applications).

18. MERV 13 filters.

19. BACnet MS/TP interface.

20. Phase monitor.

21. Powered GFI convenience outlet.

22. Vibration isolation frame with Isolators with seismic/wind rating and PE stamped calculations.

PART 3 EXECUTION

3.01 GENERAL - The packaged rooftop units are being pre-purchased by the Ventnor Public Schools. The contractor shall be responsible for the installation of the rooftop units, adapter curbs, power exhaust and all appurtenances to provide a fully functional system.

3.02 EXAMINATION

A. Contractor shall verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.

B. Contractor shall verify that proper power supply is available.

3.03 INSTALLATION

A. Contractor shall install in accordance with manufacturer's instructions.

B. Mount units on factory-built roof mounting frame providing watertight enclosure to protect ductwork and utility services. Install adapter curb level.

C. Contractor shall install and wire and applicable accessories.

3.04 CONNECTIONS

A. Contractor shall install in accordance with manufacturer's instructions.

B. Mount units on adapter curb provided by the rooftop unit manufacturer providing watertight enclosure to protect ductwork and utility services. Install adapter curb level.

C. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

D. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

E. Install ducts to termination at unit or existing plenum curb.

F. Electrical System Connections: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls.

G. Ground equipment according to Division 26 Section "Grounding and Bonding."

H. 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.

3.05 MANUFACTURER'S FIELD STARTUP SERVICES

A. The manufacturer shall provide start up and warranty service.

1. Start up by the installing contractor is NOT acceptable.
2. Inspect for visible damage to unit casing.
3. Inspect for visible damage to compressor, air-cooled outside coil, and fans.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean outside coil and inspect for construction debris.
11. Adjust vibration isolators.
12. Inspect operation of barometric dampers.
13. Lubricate bearings on fan.
14. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
15. Adjust fan belts to proper alignment and tension.
16. Start unit according to manufacturer's written instructions.

    a. Start refrigeration system in summer only.
    b. Complete startup sheets and attach copy with Contractor's startup report.

17. Inspect and record performance of interlocks and protective devices; verify sequences.
18. Operate unit for an initial period as recommended or required by manufacturer.
20. Adjust and inspect high-temperature limits.
21. Inspect outside-air dampers for proper stroke and interlock with return-air dampers.
22. Start refrigeration system and measure and record the following:

    a. Coil leaving-air, dry- and wet-bulb temperatures.

b. Coil entering-air, dry- and wet-bulb temperatures.
c. Outside-air, dry-bulb temperature.
d. Outside-air-coil, discharge-air, dry-bulb temperature.

23. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.

24. Verify the following:

    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short circuiting of air through outside coil or from outside coil to outside-air intake.

25. After startup and performance testing, change filters, vacuum heat exchanger and cooling and outside coils, lubricate bearings, adjust belt tension, and inspect operation of power vents.

B. The contractor shall furnish manufacturer complete submittal wiring diagrams of the package unit as applicable for field maintenance and service.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged air conditioners. Provide a minimum of twenty (24) hours of onsite training to the owner.

END OF SECTION 237413

SECTION 238127 –DUCTLESS SPLIT SYSTEMS

Part 1 – General

1.01 QUALITY ASSURANCE

A. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.

B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).

C. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

D. A full charge of R-410A for the condensing unit only shall be provided in the condensing unit.

1.02 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled according to the manufacturer's recommendation.

Part 2 – Warranty

2.01 The units shall be covered by the manufacturer's limited warranty for a period of one (1) year from date of installation.

In addition the compressor shall have a manufacturer's limited warranty for a period of six (6) years from date of installation.

2.02 Manufacturer shall have a minimum of twenty-five years of HVAC experience in the U.S. market.

Part 3 – Products

3.01 OUTDOOR UNIT

A. General:

The outdoor units shall perform all functions necessary for proper operation. The outdoor unit shall have a powder coated finish. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.

Provide sloped standing seam roof unit supports in accordance with the manufacturer's recommendations.

1. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of outdoor rated capacity.
2. Outdoor unit shall have a sound rating no higher than 63 dB(A).
3. All refrigerant lines from the outdoor unit to the indoor units shall be fully insulated.
4. The outdoor unit shall have an accumulator with refrigerant level sensors and controls.
5. The outdoor unit shall have a high pressure safety switch, over-current protection and DC bus protection.
6. The outdoor unit shall have the ability to operate with a maximum height difference of 164 feet and have total refrigerant tubing length of 984-1312 feet. The greatest length is not to exceed 492 feet between outdoor unit and the indoor units without the need for line size changes or traps.
7. The outdoor unit shall be capable of operating in heating down to -4°F ambient temperature without additional low ambient controls.
8. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.

B. Unit Cabinet:

1. The casing(s) shall be fabricated of galvanized steel, bonderized and finished with a powder coated baked enamel.

C. Fan:

1. The outdoor unit shall be furnished with one direct drive, variable speed propeller type fan.
2. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
3. All fan motors shall be mounted for quiet operation.
4. All fans shall be provided with a raised guard to prevent contact with moving parts.
5. The outdoor unit shall have vertical discharge airflow.

D. Refrigerant

1. R410A refrigerant shall be required for outdoor unit systems.

E. Coil:

1. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
2. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
3. The coil shall be protected with an integral metal guard.
4. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.

F. Compressor:

1. The outdoor units shall be equipped with one inverter driven scroll hermetic compressor.
2. A crankcase heater(s) shall be factory mounted on the compressor(s).
3. The outdoor unit compressor shall have an inverter to modulate capacity. The capacity shall be completely variable down to 16% of rated capacity.
4. The compressor will be equipped with an internal thermal overload.
5. The compressor shall be mounted to avoid the transmission of vibration.

G. Electrical:

1. The outdoor unit electrical power shall be as shown on the contract drawings.
2. The outdoor unit shall be controlled by integral microprocessors.
3. The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

4.01 WALL-MOUNTED INDOOR UNIT

A. General:

The wall-mounted indoor unit section shall be provided with a slim silhouette and shall have a modulating linear expansion device.

B. Indoor Unit

The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

C. Unit Cabinet:

1. The casing shall have a white finish.

2. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard.
3. There shall be a separate back plate which secures the unit firmly to the wall.

D. Fan:

1. The indoor fan shall be an assembly with one or two line-flow fan(s) direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).
4. A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.

E. Filter:

1. Return air shall be filtered by means of an easily removable, washable filter.

F. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. Both refrigerant lines to the PKFY indoor units shall be insulated.

G. Electrical:

1. The unit electrical power shall be as shown on the contract documents.

H. Controls:

1. This unit shall use controls provided by the equipment manufacturer to perform functions necessary to operate the system. Controls shall be a stand alone system with remote thermostats.

END OF SECTION 238127

SECTION 238239 - SEPARATED COMBUSTION INDOOR GAS UNIT HEATERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Separated Combustion propeller fan gas unit heater.

1.02 RELATED SECTIONS

A. Section 230500 – Common Work Requirements for HVAC

B. Section 230700 - HVAC Insulation

C. Section 230529 – Hangers and Supports for HVAC Piping and Equipment

D. Section 231123 – Facility Natural Gas Piping.

E. Section 260500 – Common Work Results for Electrical – Materials and Methods.

1.03 REFERENCES

A. ANSI/Z223.1 (NFPA 54) - National Fuel Gas Code.

B. ANSI Z 83.8 - Gas Unit Heaters

1.04 SUBMITTALS

A. Submit drawings indicating components, assembly, dimensions, weights, required clearances, location and size of field connections.

B. Submit product data indicating capacities, weights, specialties and accessories, electrical requirements and wiring diagram.

C. Submit schedule of equipment typically indicating sizes and number of units, including capacity data.

D. Submit Manufacturer's Installation Instructions. Indicate rigging, assembly, and installation instructions.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include manufacturer's descriptive literature, operating instructions, maintenance instruction and unit parts.

1.06 WARRANTY

A. Provide whole unit warranty (parts and labor) for five years from start-up or 66 months from shipment, whichever occurs first.

B. Warranty shall be provided by the manufacturer. 3rd party warranties (contractor bond, AIG, self-performance, etc.) are NOT acceptable and will be rejected.

PART 2 PRODUCTS

2.01 CENTRIFUGAL AND PROPELLER FAN UNIT HEATERS

A. Manufacturers:

1. TRANE.

2. STERLING.

3. REZNOR.

B. Units:

1. Unit shall be factory-assembled, piped, wired and test fired. The Unit shall include supply fan, heat exchanger, burners, 115 to 24V control transformer, horizontal louvers, special orifices for high altitude applications and controls.

2. Unit shall be ETL certified and conform with the latest ANSI standards. Tubular Heat Exchanger Models shall be certified for Residential Garage installation.

3. Unit shall be provided with four point suspension.

4. Unit 115 volt wiring shall be in flexible conduit.

C. Performance Ratings: Units shall have at least an 82% Thermal efficiency rating.

D. Casing shall be die-formed, 20 gauge galvanized steel and finished in baked enamel. The bottom panel shall be easily removed to provide service access to the burners, pilot and orifices. The pilot shall also be accessible through a side panel access plate.

E. Fan - Fan blades shall be constructed of aluminum with an aerodynamic contour. All fans shall be dynamically balanced for quiet, efficient operation and supplied with a protective type fan guard. Rubber-in-shear isolators shall provide isolation between the fan/motor combination and the unit heater casing.

F. Motor - Motor shall be totally enclosed (TEFC) with built-in thermal overload protection.

G. Separated Combustion

1. Low profile tubular propeller unit heaters shall be installed in a separated combustion venting configuration.

2. Separated combustion venting requires installing a sealing gasket (included with each unit) and then connecting combustion air inlet piping to the inlet collars, which encloses the burner, spark ignitor, and flue system within the unit, "separating" the entire combustion process from the environment where the unit is installed.

3. Separated combustion units shall be vented horizontally or vertically via standard two-pipe configuration (one pipe for inlet/combustion air, one for exhausting flue products).

    a. When it is necessary to vent concentrically through one wall or roof penetration, a combustion air inlet kit should be installed.

H. Tubular Heat Exchanger shall be supplied, on propeller style models, and shall consist of 20-gauge stainless steel of curved, non-welded serpentine design. This shall be equipped with a hot surface pilot ignition, constructed of shock resistant ceramic composite hot surface element. This design shall experience less thermally induced stress making it highly durable for longer service life.

I. Direct Spark Ignition

1. Tubular units shall utilize a direct spark pilotless ignition of the burner, providing fast heat delivery. When there is a call for heat, the single stage, redundant gas valve shall open and the igniter shall provide a spark in an attempt to light the in-shot burners. The burner flame shall be proven by the flame sensor and continue to burn until the call for heat is satisfied.

2. This highly reliable and efficient ignition system shall incorporate an integrated electronic control board to regulate the system sequence of operation, including an onboard LED indicator for simple troubleshooting.

J. Flue Collector- Flue Collector construction shall be type 409 stainless steel.

K. Venting

1. The tubular design shall be ETL certified in accordance with Categories I and III venting requirements. Category I enables units to be vented vertically with either single- or double wall, or B-vent venting material. Category III allows for horizontal or vertical venting utilizing single- or double-wall venting material.

L. Control Accessibility

1. The control transformer and pressure switch shall be factory mounted in a main control cabinet located on the side of the unit. The side panel shall be removable for easy access.

M. CONTROLS:

1. A factory-installed junction box shall be provided for all power connections. A 24-volt transformer, high limit and a fan time delay relay shall be provided.

2. The fan time delay relay delays the fan start until the heat exchanger reaches a predetermined temperature. It also allows the fan to operate after burner shutdown, removing residual heat from the heat exchanger.

3. The unit shall be provided with a 24-volt combination two-stage redundant gas valve, consisting of a combination, automatic electric gas valve, pressure regulator, and manual shutoff. A flue vent fan relay and combustion air proving switch shall also be provided. Equipment shall include direct spark-ignition with electronic flame supervision.

N. Operating Controls:

1. Room Thermostat: Low voltage, two-stage to control heater stages, to maintain temperature setting. Include fan control switch.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that space is ready for installation of units and openings are as indicated on submittal drawings.

B. Verify that proper power supply is available.

C. Verify that proper fuel supply is available for connection.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install to NFPA 90A and/or ANSI/NFPA 90B.

C. Install gas fired units to ANSI Z223.1 (NFPA 54).

D. Provide vent connections to ANSI/NFPA 211. Refer to Section 15575.

E. Install devices furnished by manufacturer but not factory mounted. Furnish copy of manufacturers wiring diagram.

END OF SECTION 238239

SECTION 238240 - ELECTRIC CABINET AND UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cabinet unit heaters with centrifugal fans and electric-resistance heating coils.
2. Propeller unit heaters with electric-resistance heating coils.
3. Wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.2 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.

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. Plans, elevations, sections, and details.
2. Location and size of each field connection.
3. Equipment schedules to include rated capacities, furnished specialties, and accessories.

C. Field quality-control test reports.

D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 CABINET UNIT HEATERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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

C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
   1. Carrier Corporation.
   2. Chromalox, Inc.; a division of Emerson Electric Company.
   3. Markel Products; a division of TPI Corporation. (Basis of Design)
   4. Trane.

D. Description: A factory-assembled and -tested unit complying with ARI 440.

   1. Comply with UL 2021.

E. Coil Section Insulation: Glass-fiber insulation; surfaces exposed to airstream shall be erosion-resistant coating to prevent erosion of glass fibers.

F. Cabinet: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect.

   1. Vertical Unit, Exposed Front Panels: Minimum 0.0677-inch-thick, sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
   2. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0677-inch-thick, sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.

   3. Recessing Flanges: Steel, finished to match cabinet.
   4. Control Access Door: Key operated.

   5. Base: Minimum 0.0528-inch-thick steel, finished to match cabinet, with leveling bolts.

G. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

   1. Washable Foam: 70 percent arrestance and 3 MERV.
   2. Glass Fiber Treated with Adhesive: 80 percent arrestance and 5 MERV.
   3. Pleated: 90 percent arrestance and 7 MERV.

H. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.

I. Fan and Motor Board: Removable.

1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.

2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
3. Wiring Terminations: Connect motor to chassis wiring with plug connection.

J. Control devices and operational sequences are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls."

K. Basic Unit Controls:

1. Control voltage transformer.

2. Wall-mounting thermostat with the following features.

a. Heat-off switch.
b. Fan on-auto switch.

c. Manual fan speed switch.
d. Adjustable deadband.
e. Deg F (Deg C) indication.

L. DDC Terminal Controller:

1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
2. Unoccupied Period Override: 2 hours.
3. Unit Supply-Air Fan Operations:

a. Occupied Periods: Fan cycles to maintain setback room temperature.
b. Unoccupied Periods: Fan cycles to maintain setback room temperature.

4. Heating Coil Operations:

a. Occupied Periods: Energize electric-resistance coil to provide heating if room temperature falls below thermostat set point.
b. Unoccupied Periods: Start fan and energize electric-resistance coil if room temperature falls below setback temperature.

5. Controller shall have volatile-memory backup.

M. Electrical Connection: Factory wire motors and controls for a single field connection.

2.2 WALL AND CEILING HEATERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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

C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
   1. Chromalox, Inc.; a division of Emerson Electric Company.
   2. Markel Products; a division of TPI Corporation. (Basis of Design)
   3. Trane.

D. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

E. Cabinet:

   1. Front Panel: Extruded-aluminum bar grille, with removable panels fastened with tamperproof fasteners.
   2. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.

F. Surface-Mounting Cabinet Enclosure: Steel with finish to match cabinet.

G. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high temperature protection. Provide integral circuit breaker for overcurrent protection.

H. Fan: Aluminum propeller directly connected to motor.

   1. Motor: Permanently lubricated, multispeed. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

I. Controls: Unit-mounted thermostat. Low-voltage relay with transformer kit.

J. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install unit heaters to comply with NFPA 90A.

B. Suspend cabinet unit heaters from structure with elastomeric hangers. Vibration isolators are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers with vertical-limit stop. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

D. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

E. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of unit heater.

F. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

G. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

H. Install piping adjacent to machine to allow service and maintenance.

I. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.

J. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."

K. Comply with safety requirements in UL 1995.

L. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

M. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 238240

SECTION 260450 - ELECTRICAL DEMOLITION & RENOVATION

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 REFERENCE CODES AND STANDARDS

A. The work shall conform to:

1. National Electrical Code
2. State and Local Codes

PART 2 - PRODUCTS

2.1 Materials used for this work shall be in accordance with the applicable specification sections in Division 16.

PART 3 - EXECUTION

3.1 Provide demolition, relocation, and alteration of electrical construction as required.

A. The contractor shall notify the owner 48 hours in advance of any interruptions of electric service to any area of the building.

B. All interruptions of electric service shall be kept to a minimum. Where power is to be interrupted longer than twenty (20) minutes, the work shall be done after normal business hours, and where necessary, temporary power shall be provided by means of additional temporary feeds or by means of a generator.

C. Should the electrical service be disrupted due to construction while the building is occupied the contractor shall provide temporary electrical power at no additional cost to the contract.

3.2 Check the locations of all existing electrical work, such as lighting fixtures, electrical conduit, wiring, fittings, controls, starters and other electrical construction and provide the removing, relocating, rerouting, and reconnecting of this work due to demolition and new construction. Any existing apparatus or wiring device to be retained shall be disconnected, relocated and reinstalled as required, to allow for new wall, floor or ceiling finishes.

3.3 Methods of installation and standards of workmanship shall be in accordance with the applicable specification sections under Division 26.

3.4 Where existing equipment will remain in service during construction, provide rerouting and reconnection of electrical service as required.

3.5 Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the work, remove damaged portions and install new products of equal capacity, quality, and functionality.

3.6 Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

3.7 Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches (50 mm), below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.

3.8 Remove demolished material from project site. Any particular equipment that the owner wants saved shall be stored as directed.

3.9 Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

3.10 Feeders or circuits, whether spliced, extended, relocated or new, shall maintain amperage and continuity of that respective feeder or circuit.

3.11 Where new work interferes with existing work or other trades, relocate such existing work without additional cost. Approval by the Owner's Representative must be given before any relocation work can begin. The relocation work shall be done in a manner acceptable to the Owner. Engage Contractor of the appropriate trade to do the work.

END OF SECTION 260450

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL – MATERIALS AND METHODS GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Raceways.
2. Building wire and connectors.
3. Supporting devices for electrical components.
4. Electrical identification.
5. Utility company electricity-metering components.
6. Concrete equipment bases.
7. Electrical demolition.
8. Cutting and patching for electrical construction.

1.2 SUBMITTALS

A. Product Data: For utility company electricity-metering components.

B. Shop Drawings: Dimensioned plans and sections or elevation layouts and single-line diagram of electricity-metering component assemblies specific to this Project.

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. The contractor shall be fully responsible for all coordination of the electrical work required to meet the design intent and the scope of work related to the project. This includes but not limited to all other trades, material handling, equipment rentals, tools, automobiles, parking and travel expenses, engineering review and consult, as-built drawings and any/all construction site requirements that are necessary to provide a turnkey electrical installation.

C. The ‘Basis of Design’ is the product that is specified which supports the design data contained within the contract documents. Should the contractor elect to use an alternate manufacturer listed within the specifications the contractor is still required to meet the full intent and specifications and the contract documents. Any deviation of the contract documents will be the sole responsibility of the contractor to maintain specification requirements at no additional cost to the owner.

D. It shall be the contractor’s responsibility to acknowledge any long lead delivery items with written response from the manufacturer, at the time of Notice to Proceed. Should the contractor fail to inform the client and the A/E of any material or equipment delays at the time Notice to Proceed has been given, the contractor will take full responsibility in completing the project in the same allowed construction period, based on the approved construction schedule.

E. The contractor shall be fully responsible in the coordination and installation of all electrical products as per the manufacturer's recommendations. Should the contractor alter or change the manufacturer's installation recommendations, the contractor shall submit a certified installation report from the manufactures representative stating the installed is acceptable. Any discrepancies in the installation shall be corrected per the manufacturer's requirements at no additional cost to the owner and before final closeout of the project.

F. Devices for Utility Company Electricity Metering: Comply and coordinate with local utility company requirements and Specification Section 262713 – Electricity Metering.

G. Comply with NFPA 70.

1.4 COORDINATION

A. The contractor shall be fully responsible for the coordination of all electrical work required to meet the design intent and the scope of work related to the project. This includes but not limited to all other trades, material handling, equipment rentals, rigging equipment, cranes, high reach man lifts, tools, automobiles, parking and travel expenses, engineering review and consult, as-built drawings and any/all construction site requirements that are necessary to provide a turnkey electrical installation.

B. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

C. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

D. Coordinate electrical service connections to components furnished by utility companies.

1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

E. Devices for Utility Company Electricity Metering: Comply and coordinate with local utility company requirements and published standards.

F. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.

G. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

H. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

I. The contractor shall field verify all existing conductor phasing for each individual circuit feeder whether it be primary or secondary feeds to and from the new electrical equipment. The contractor is fully responsible for tagging and phasing all branch circuits. Any disruption or equipment failure caused by phase crossing shall be the full responsibility of the contractor to replace and or repair any/all damages that may occur at no additional cost.

1.5 ITEMS NOT SHOWN OR SPECIFIED

A. Any item of material not indicated on the drawings and/or not specified, but which is required for the complete and proper installation and/or operation of any part of the work, shall be provided as if indicated and specified, at no additional cost to the Owner.

B. Any work not indicated on the drawings and/or not specified, but which is required for compliance with applicable codes and regulations, shall be provided as if indicated and specified, at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 RACEWAYS

A. EMT: Electrical metallic tubing; ANSI C80.3, zinc-coated steel, with compression fittings.

B. FMC: Flexible metal conduit; zinc-coated steel.

C. IMC: Intermediate metal conduit; ANSI C80.6, zinc-coated steel, with threaded fittings.

D. LFMC: Liquidtight flexible metal conduit; zinc-coated steel with sunlight-resistant and mineral-oil-resistant plastic jacket.

E. RMC: Rigid metal conduit; galvanized rigid steel; ANSI C80.1.

F. RNC: Rigid nonmetallic conduit; NEMA TC 2, Schedule 40 PVC, with NEMA TC3 fittings.

G. Raceway Fittings: Specifically designed for raceway type with which used.

2.2 WIRES, CABLES, AND CONNECTIONS

A. Conductors, No. 10 AWG and Smaller: Solid or stranded copper.

B. Conductors, Larger Than No. 10 AWG: Stranded copper.

C. Insulation: Thermoplastic, rated 600 V, 75 deg C minimum, Type THW, THHN-THWN, or USE depending on application..

D. Wire Connectors and Splices: Units of size, ampacity rating, material, type, and class suitable for service indicated.

2.3 SUPPORTING DEVICES

A. Material: Cold-formed steel, with corrosion-resistant coating.

B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.

C. Slotted-Steel Channel: Flange edges turned toward web, and 9/16-inch- (14-mm-) diameter slotted holes at a maximum of 2 inches (50 mm) o.c., in webs. Strength rating to suit structural loading.

D. Nonmetallic Slotted Channel and Angle: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (203 mm) o.c., in at least one surface. Strength rating to suit structural loading.

E. Slotted Channel Fittings and Accessories: Recommended by the manufacturer for use with the type and size of channel with which used.

1. Materials: Same as channels and angles, except metal items may be stainless steel.

F. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

G. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

H. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.

I. Expansion Anchors: Carbon-steel wedge or sleeve type.

J. Toggle Bolts: All-steel springhead type.

K. Powder-Driven Threaded Studs: Heat-treated steel.

2.4 ELECTRICAL IDENTIFICATION

A. Identification Device Colors: Use those prescribed by ANSI A13.1, NFPA 70, and these Specifications.

B. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick (25 mm wide by 0.08 mm thick).

C. Tape Markers for Conductors: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

D. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.

E. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape compounded for permanent direct-burial service, and with the following features:

1. Not less than 6 inches wide by 4 mils thick (150 mm wide by 0.102 mm thick).
2. Embedded continuous metallic strip or core.
3. Printed legend that indicates type of underground line.

F. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch (1.6-mm) minimum thickness for signs up to 20 sq. in. (129 sq. cm) and 1/8-inch (3.2-mm) minimum thickness for larger sizes. Engraved legend in black letters on white background.

G. Warning and Caution Signs: Preprinted; comply with 29 CFR 1910.145, Chapter XVII. Colors, legend, and size appropriate to each application.

1. Interior Units: Aluminum, baked-enamel-finish, punched or drilled for mechanical fasteners.
2. Exterior Units: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate with 0.0396-inch (1-mm), galvanized-steel backing. 1/4-inch (6-mm) grommets in corners for mounting.

H. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.5 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

A. Comply with requirements of the local electrical power utility company for meter sockets and current transformer cabinet and as per Specification Section 262713 – Electricity Metering.

B. Provide Cold Sequence Meter Protection Switch as required by the Local Utility Company.

C. The contractor shall coordinate and provide any/all metering equipment for low and medium voltage equipment provisions not directly supplied by the local utility company.

2.6 CONCRETE BASES

A. Provide 6” high concrete sub-bases for all floor mounted electrical equipment within spaces that are below exterior finished grade and/or in spaces that are installed where water or liquids may be dispersed from local equipment or building appurtenances.

B. Where concrete bases are required, provide approved anchoring systems and methods to apply the base to the flooring and for the equipment being supported.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT 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.

B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Electrical equipment shall be installed at elevations where the disconnecting means is not greater than 6'-6" above the accessible, working floor elevation (unless noted otherwise).

E. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 RACEWAY APPLICATION

A. Outdoor Installations:

1. Exposed: RMC.
2. Concealed: RNC.
3. Underground, Single Run: RNC.
4. Underground, Grouped: RNC.
5. Connection to Vibrating Equipment: LFMC.
6. Boxes and Enclosures: NEMA 250, Type 3R or Type 4, unless otherwise indicated.

B. Indoor Installations:

1. Exposed: EMT except in wet or damp locations, use IMC.
2. Concealed in Walls or Ceilings: FMC.
3. In Concrete Slab: RNC.
4. Below Slab on Grade or in Crawlspace: RNC
5. Connection to Vibrating Equipment: FMC; except in wet or damp locations: LFMC.
6. Boxes and Enclosures: NEMA 250, Type 1, unless otherwise indicated.

3.3 RACEWAY AND CABLE INSTALLATION

A. Conceal raceways and cables, unless otherwise indicated, within finished walls, ceilings, and floors.

B. Keep legs of raceway bends in the same plane and keep straight legs of offsets parallel.

C. Use RMC elbows where RNC turns out of slab.

D. Where required to provide a Rough-in Only device application concealed within the vertical walls the contractor shall provide the device work box and ¾" EMT raceway to above the ceiling with a 90 degree bend turned into the ceiling space and apply an open end plastic bushing or cap for future wiring application.

E. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or woven polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wires.

F. Connect motors and equipment subject to vibration, noise transmission, or movement with a maximum of 72-inches (1830-mm) flexible conduit. Install LFMC in wet or damp locations. Install separate ground conductor across flexible connections.

3.4 WIRING METHODS FOR POWER, LIGHTING, AND CONTROL CIRCUITS

A. Application: Use wiring methods specified below to the extent permitted by applicable codes as interpreted by authorities having jurisdiction.

B. Exposed Feeders: Insulated single conductors in raceway.

C. Concealed Feeders in Concrete: Insulated single conductors in PVC raceway.

D. Exposed Branch Circuits Insulated single conductors in raceway.

E. Concealed Branch Circuits: Insulated single conductors in FMC raceway.

F. Underground Feeders and Branch Circuits: Insulated single conductors in raceway.

G. Remote-Control Signaling and Power-Limited Circuits, Classes 1, 2, and 3: Insulated conductors in FMC raceway unless otherwise indicated.

H. Provide PVC pipe sleeves for all non-fire rated interior masonry and below grade wall penetrations. Provide caulk/sealant of all wall penetrations installed.

I. Provide Rigid metallic pipe sleeves for all fire rated masonry and exterior wall penetrations. Provide the rated fire caulk/sealant for all wall penetrations that match the rating of the fire wall.

3.5 WIRING INSTALLATION

A. The contractor shall minimize all wire splices or taps. Should the need to provide splices or taps provide materials that are compatible with the connecting conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.

B. Unless specified otherwise the contractor shall not exceed four (4) current carrying conductors plus ground in a single raceway.

3.6 ELECTRICAL SUPPORTING DEVICE APPLICATION

A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, slotted channel system components.

B. Dry Locations: Steel materials.

C. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four with, 200-lb (90-kg) minimum design load for each support element.

3.7 SUPPORT INSTALLATION

A. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

B. Size supports for multiple raceway or cable runs so capacity can be increased by a 25 percent minimum in the future.

C. Support individual horizontal single raceways with separate, malleable-iron pipe hangers or clamps.

D. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used in existing walls or floors. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

E. Secure electrical items and their supports to building structure, using the following methods unless other fastening methods are indicated:

1. Wood: Wood screws or screw-type nails.
2. Gypsum Board: Toggle bolts. Seal around sleeves with joint compound, both sides of wall.
3. Masonry: Toggle bolts on hollow block and expansion bolts on solid block. Seal around sleeves with mortar, both sides of wall.
4. New Concrete: Concrete inserts with machine screws and bolts.
5. Existing Concrete: Expansion bolts or threaded studs driven by powder charge and provided with lock washers.
6. Structural Steel: Welded threaded studs.

    a. Comply with AWS D1.1 for field welding.

7. Light Steel Framing: Sheet metal screws.
8. Fasteners for Damp, Wet, or Weather-Exposed Locations: Stainless steel.
9. Light Steel: Sheet-metal screws.
10. Fasteners: Select so load applied to each fastener does not exceed 25 percent of its proof-test load.

3.8 FIRESTOPPING

A. Apply firestopping to cable and raceway sleeves and other penetrations of fire-rated floor and wall assemblies to restore original undisturbed fire-resistance ratings of assemblies.

3.9 DEMOLITION

A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.

B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety and back to electrical panel source..

C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches (50 mm) below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.

D. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

3.10 TEMPORARY ELECTRICAL POWER / SERVICES

A. Provide all necessary temporary electrical construction power by either a temporary service power pole or by portable generator to maintain adequate electrical power requirements for the duration of construction, at no additional cost to the project or owner.

B. Should the project include demolition or disruption of an existing electrical service the contractor shall provide temporary back-up power source and connection that meets the demand requirements of the disturbed service at no additional cost to the project or owner.

3.11 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair, refinish and touch up disturbed finish materials and other surfaces to match adjacent undisturbed surfaces.

END OF SECTION 260500

SECTION 260519 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS

A. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.4 QUALITY ASSURANCE

A. Listing and Labeling: Provide wires and cables specified in this Section that are listed and labeled.

1. The Terms ″Listed″ and ″Labeled″ as defined in NFPA 70, Article 100.
2. Listing and Labeling Agency Qualifications: A ″Nationally Recognized Testing Laboratory″ as defined in OSHA Regulation 1910.7.

B. Comply with NFPA 70.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver wires and cables according to NEMA WC 26.

1.6 COORDINATION

A. Coordinate layout and installation of cables with other installations.

B. Revise locations and elevations from those indicated, as required to suit field conditions and as approved by Engineer.

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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 CONDUCTORS AND CABLES

A. Manufacturers:

1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Rome Cable Company.

B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

C. Conductor Material: Copper complying with NEMA WC 5 or 7; solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.

D. Conductor Insulation Types: Type THW, THHN-THWN, XHHW and SO complying with NEMA WC 5 or 7.

E. Conductor Insulation Type: Type XHHW where used exterior and below grade or in extreme wet location areas.

F. Multi-conductor Cable: Armored cable Type FAC, Metal-clad cable Type FMC, and Type SO with ground wire. Armor shall be steel interlocked covering in NEMA 1 applications.

2.3 CONNECTORS AND SPLICES

A. Manufacturers:

1. AFC Cable Systems, Inc.
2. AMP Incorporated/Tyco International.
3. Hubbell/Anderson.
4. O-Z/Gedney; EGS Electrical Group LLC.
5. 3M Company; Electrical Products Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.4 HEAT TRACE CABLES AND COMPONENTS

A. Provide a heat trace freeze protection system for above ground piping with a minimum rating of -20°F. Basis of Design: Raychem by Tyco Thermal Controls.

Other Approved Manufacturers:
1. Nelson Heat Trace – Emerson Industrial Automation

B. The Raychem XL-Trace System shall be provided with all required control monitoring devices and 30-mA ground fault protection.device.

C. System shall be UL listed and FM approved for non-hazardous locations. Where hazardous locations apply comply with all current NFPA and EPA requirements.

D. The self regulating, Raychem 12XL2 (12 watt/ft) heating cable shall be permanently secured to the metallic pipes with Raychem GT-66 glass reinforced tape. The cable shall be minimum 20 amp, 208 volt rated.

E. For above ground system include the following devices:
   1. Power Connector – RayClip-PC
   2. Electronic thermostat – Raychem model EC-TS-AM8.
   3. Splices – RayClic-S
   4. Tees – RayClic-T
   5. End seal – RayClic – E
   6. Provide all miscellaneous installation components required by the manufacturer for a turnkey installation.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Service Entrance: Type THHN-THWN, single conductors in raceway, XHHW, single conductors in raceway.

B. Exposed Feeders in raceway: Type THHN-THWN.

C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in EMT, FAC or FMC raceway.

D. Feeders Concealed in Concrete or below Slabs-on-Grade: Type THHN-THWN, single conductors in PVC raceway.

E. Exposed Branch Circuits, including in Crawlspaces: Type THHN-THWN, single conductors in raceway that meets the crawlspace environment (no FAC or FMC).

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway, Electrical Metallic Tubing Type EMT, Armored cable Type FAC, or Metal-clad cable Type FMC.

G. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single conductors in PVC raceway.

H. Branch circuit homeruns exposed: Type THHN-THWN, single conductors in EMT or RMC.

I. Cord Drops and Portable Appliance Connections: Type SO, hard service cord sized in accordance with the overcurrent protection device (breaker or fuse size) ‘not’ the amperage rating of the appliance.

J. Exposed Fire Alarm Circuits: Type THHN-THWN, in raceway or Power-limited, fire-protective, signaling circuit cable in steel armor spiral cover, colored red or labeled EMT.

K. Exposed Fire Alarm Circuits where existing architecturally finished wall surfaces exist to remain, the contractor shall provide Surface Mounted Raceway (such as Wiremold).

L. Class 1 Control Circuits: Type THHN-THWN, in raceway.

M. Class 2 Control Circuits: Power-limited cable, concealed in building finishes (above acoustical ceilings and walls).

3.2 INSTALLATION

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means; including fish tape, cable, rope, and basket-weave wire/cable grips, which will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers & Supports"

F. Provide an additional four hundred linear feet of cable/conductor and accessories of each type and size used on the project to accommodate any changes required to resolve interferences as directed by the Engineer.

G. Seal around cables penetrating fire-rated elements according to Division 7 Section "Through-Penetration Firestop Systems."

H. Identify and color-code conductors and cables according to Division 16 Section "Electrical Identification."

3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.4 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.
3. It is the electrical contractor's responsibility to confirm all wire and cable installations meet the necessary inspections and testing indicated in item 260519-3.4A paragraph #2 of this section. Should any failures be found during or immediately after construction the contractor will be required to provide and third party NETA testing agency to prepare a detailed inspection and approval report detailing all corrective measures at no additional cost. In addition the contractor will be required to replace 100% of all damaged or failing installations at the contractor's expense. Should any work require replacement the contractor will be required to provide at no additional cost another NETA testing inspection to confirm corrective measure have been met.

B. Test Reports: Prepare a written report to record the following should 260519-3.4A paragraph #3 be required:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Requirements specified in this Section may be supplemented by requirements of other Sections.

1.2 SUBMITTALS

A. Product Data: For ground rods and chemical rods.

B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled under UL 467 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; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.

C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

1.4 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. Ground Rods-Provide an additional 4 ground rods of each type and size utilized on this project.
2. Ground Conductors-Provide an additional 150 feet of each ground conductor type and size utilized on this project.
3. Ground Connections-Provide an additional 4 connections of each type and size utilized on this project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Apache Grounding/Erico Inc.
2. Boggs, Inc.
3. Chance/Hubbell.
4. Copperweld Corp.
5. Dossert Corp.
6. Erico Inc.; Electrical Products Group.
7. Framatome Connectors/Burndy Electrical.
8. Ideal Industries, Inc.
9. ILSCO.
10. Kearney/Cooper Power Systems.
11. Korns, C. C. Co.; Division of Robroy Industries.
12. Lightning Master Corp.
13. Lyncole XIT Grounding.
14. O-Z/Gedney Co.; a business of the EGS Electrical Group.
15. Raco, Inc.; Division of Hubbell.
16. Robbins Lightning, Inc.
17. Salisbury, W. H. & Co.
18. Superior Grounding Systems, Inc.
19. Thomas & Betts, Electrical.

2.2 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 16 Section "Conductors and Cables."

B. Equipment Grounding Conductors: Insulated with green-colored insulation.

C. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.

D. Grounding Electrode Conductors: Stranded cable.

E. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.

F. Bare, Solid-Copper Conductors: ASTM B 3.

G. Assembly of Bare, Stranded-Copper Conductors: ASTM B 8.

H. Bare, Tinned-Copper Conductors: ASTM B 33.

I. Copper Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.

J. Copper Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.

K. Tinned-Copper Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.

L. Ground Conductor for Overhead Distribution: No. 4 AWG minimum, soft-drawn copper.

M. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulated spacer.

N. Connectors: Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items. Compression type or exothermic-welded type, in kit form, selected per manufacturer's written instructions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel.

B. Ground Rods: Sectional type; copper-clad steel.

1. Size: **3/4 by 120 inches (19 by 3000 mm)** in diameter.

C. Chemical Electrodes: Copper tube, straight or L-shaped, filled with nonhazardous chemical salts, terminated with a 4/0 bare conductor. Provide backfill material recommended by manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

B. In raceways, use insulated equipment grounding conductors.

C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections.

D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Use insulated spacer; space 1 inch (25.4 mm) from wall and support from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the indicated height above the floor.

E. Underground Grounding Conductors: Use tinned-copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches (600 mm) below grade or bury 12 inches (300 mm) above duct bank when installed as part of the duct bank.

F. Equipment Grounding Conductors: Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

1. Install insulated equipment grounding conductors in feeders and branch circuits.

2. Busway Supply Circuits: Install insulated equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
3. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.
4. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
5. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install an insulated equipment grounding conductor. Isolate equipment grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
6. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
7. Air-Duct Equipment Circuits: Install an insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.
8. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install an insulated equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.

9. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

    a. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6.4-by-50-by-300-mm) grounding bus.
    b. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

10. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing an insulated equipment grounding conductor with supply branch-circuit conductors.

11. Common Ground Bonding with Lightning Protection System: Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

G. Metal Frame Grounding for Buildings: Drive a ground rod at the base of every corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart. Connect rod to column with an underground grounding conductor. Interconnect ground rods with a continuous underground conductor, extending around the perimeter of the building, 24 inches

(600 mm) minimum from building foundation. Use tinned-copper conductor not less than No. 2/0 AWG for underground conductor, and bury 18 inches (450 mm) below grade, minimum.

H. Building Ground Rings: Provide a perimeter ground ring for the entire building as required per the National Electrical Code Article 250.66C.

I. Bond all concrete encased electrode (foundation/footing reinforcing) Provide as required per National Electrical Code Article 250.66B.

J. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.

1. Drive ground rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except as otherwise indicated. Make connections without exposing steel or damaging copper coating.

K. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

L. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers or supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

M. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp 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.

N. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

O. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

P. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

Q. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

R. Connections: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
6. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
7. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
8. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
9. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
10. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
11. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

S. Overhead Line Grounding: Comply with IEEE C2 except where stricter requirements are indicated. Use 2 or more parallel ground rods if a single ground rod electrode resistance to ground exceeds 25 ohms.

1. Drive ground rods to a depth of 12 inches (300 mm) below finished grade in undisturbed earth.
2. Ground Rod Connections: Use clamp-type connectors listed for the purpose for underground connections and connections to rods.
3. Lightning Arresters: Separate arrester grounds from other grounding conductors.
4. Secondary Neutral and Tank of Transformer: Interconnect and connect to grounding conductor.
5. Protect grounding conductors on surface of wood poles with molding extended from grade level up to and through communication service and transformer spaces.

T. Duct Banks: Install a grounding conductor with at least 50 percent ampacity of the largest phase conductor in the duct bank.

U. Manholes and Handholes: Install a driven ground rod close to wall and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

V. Connections to Manhole Components: Connect exposed-metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

W. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise circling pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Use tinned-copper conductor not less than No. 2 AWG for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 inches (450 mm) below grade and 6 inches (150 mm) from the foundation.

3.2 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is indicated and at service disconnect enclosure grounding terminal. Measure ground resistance not less than two 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 81.
3. Provide drawings locating each ground rod, 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. Nominal maximum values are as follows:

    a. Equipment Rated 500 kVA and Less: 10 ohms.
    b. Equipment Rated 500 to 1000 kVA: 5 ohms.
    c. Equipment Rated More Than 1000 kVA: 3 ohms.
    d. Overhead Distribution Line Equipment: 25 ohms.
    e. Substations and Pad-Mounted Switching Equipment: 5 ohms.
    f. Manhole Grounds: 10 ohms.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.2 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of **five (5)** times the applied force.

1.3 SUBMITTALS

A. Product Data: For steel slotted support systems.

B. Shop Drawings Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Equipment supports.

C. Welding certificates.

1.4 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Allied Tube & Conduit.
      b. Cooper B-Line, Inc.; a division of Cooper Industries.
      c. ERICO International Corporation.
      d. GS Metals Corp.
      e. Thomas & Betts Corporation.
      f. Unistrut; Tyco International, Ltd.

   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. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: **Steel** hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

   1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

         1) Hilti Inc.
         2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
         3) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, **stainless** steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

3. 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.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as **required by** NFPA 70. Minimum rod size shall be 3/8 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least **50** percent in future without exceeding specified design load limits.

   1. Secure raceways and cables to these supports with **two-bolt conduit clamps** and/or **single-bolt conduit clamps using spring friction action for retention in support channel**.

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. To Steel: **Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69**.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate **by means that meet seismic-restraint strength and anchorage requirements**.

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. Provide an additional 20 metal supports with required fasteners of each size and type used on the project to accommodate any changes required to resolve interferences or directed by the Engineer..

D. 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 4000-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 (0.05 mm).

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

END OF SECTION 260529

SECTION 260533 – RACEWAYS & BOXES

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 raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Division 26 Section "Underground Ducts" for exterior ductbanks, manholes, and underground utility construction.
2. Division 26 Section "Basic Electrical Materials and Methods" for supports, anchors, and identification products.
3. Division 26 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT (PVC): Electrical nonmetallic tubing.

C. FAC: Flexible armored conduit.

D. FMC: Flexible metal conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquidtight flexible metal conduit.

G. LFNC: Liquidtight flexible metal conduit.

H. RMC: Rigid Metal Conduit.

I. RNC (PVC): Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, 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.

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 METAL CONDUIT AND TUBING

A. Manufacturer:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Anamet Electrical, Inc.; Anaconda Metal Hose.
4. Electri-Flex Co.
5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
6. LTV Steel Tubular Products Company.
7. Manhattan/CDT/Cole-Flex.
8. O-Z Gedney; Unit of General Signal.
9. Wheatland Tube Co.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. EMT and Fittings: ANSI C80.3.

1. Fittings: Compression type up to 1-1/2 in. conduit, 2 in. and larger use set screw type.

E. FMC: Zinc-coated steel.

F. LFMC: Flexible steel conduit with PVC jacket.

G. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.3 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

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. AFC Cable Systems; a part of Atkore International.
    b. Anamet Electrical, Inc.
    c. Arnco Corporation.
    d. CANTEX INC.
    e. CertainTeed Corporation.
    f. Lamson & Sessions.
    g. RACO; Hubbell.
    h. Thomas & Betts Corporation; A Member of the ABB Group.

B. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1. ENT: Comply with NEMA TC 13 and UL 1653.
2. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
3. LFNC: Comply with UL 1660.

C. Nonmetallic Fittings:

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. AFC Cable Systems; a part of Atkore International.
    b. Anamet Electrical, Inc.
    c. Arnco Corporation.
    d. CANTEX INC.
    e. CertainTeed Corporation.
    f. Lamson & Sessions.
    g. RACO; Hubbell.
    h. Thomas & Betts Corporation; A Member of the ABB Group.

2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
4. Fittings for LFNC: Comply with UL 514B.
5. Pipe Solvents and Adhesives: As recommended by conduit manufacturer.

2.4 METAL WIREWAYS

A. Manufacturer:

1. Hoffman.

2. Square D.

.

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1 or 3R.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, plastic edge covers, and other fittings to match and mate with wireways as required for complete system.

D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

E. Wireway Covers: Screw cover type, Flanged and gasketed type at exterior.

F. Finish: Manufacturer's standard enamel finish.

2.5 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard grey finish coat.

1. Manufacturer:
   a. Legrand
   b. Panduit.

B. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

C. Surface Non-Metallic Raceways: Polyvinyl with snap-on covers. Finish with manufacturer's light ivory color. Note, see drawings for locations where acceptable, provide metallic unless noted otherwise.

1. Manufacturer:
   a. Hubbell Inc.
   b. Legrand
   c. Panduit

D. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

1. Single channel polyvinyl (raceway for branch circuit power and/or low potential services shall be Premise Trak (Latching) as manufactured by Hubbell.
2. The two-piece single channel shall consist of a base section, 5 feet length, latching snap on cover, 0.38 in 2 channel base. Provide 1-gang or 2-gang boxes as required. Apply channel with mechanical fasteners. Adhesives and tapes are NOT acceptable.
3. Two channel polyvinyl raceway for branch circuit power and low potential services shall be Wall Trak as manufactured by Hubbell.
4. The two-piece, two channel raceway shall consist of a base section, 5 feet length, latching snap on cover, 0.81 in 2 and 0.79 in2 channel bases. Provide 1-gang or 2-gang boxes as required. Apply base with mechanical fasteners. Adhesives and tapes are NOT acceptable.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturer:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. Emerson/General Signal; Appleton Electric Company.
3. Erickson Electrical Equipment Co.
4. Hoffman.
5. Hubbell, Inc.; Killark Electric Manufacturing Co.
6. O-Z/Gedney; Unit of General Signal.
7. RACO; Division of Hubbell, Inc.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Com.; Adalet-PLM Division.
10. Spring City Electrical Manufacturing Co.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

D. Floor Boxes: Cast metal, fully adjustable, rectangular.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

H. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.7 FACTORY FINISHES

A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard gray paint applied to factory-assembled surface raceways, enclosures, and cabinets before shipping.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors:

1. Exposed: Rigid galvanized steel: RMC or IMC.

2. Concealed: Rigid galvanized steel or IMC.
3. Underground, Single Run: RMC or RNC.
4. Underground, Grouped: RMC or RNC.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Boxes and Enclosures: NEMA 250, Type 3R or 4.

B. Indoors:

1. Exposed: EMT, surface metal raceway.
2. Concealed: EMT, FAC, FMC.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
4. Damp or Wet Locations: Rigid galvanized steel conduit.
5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
   a. Damp or Wet Locations: NEMA 250, Type 4..

C. Minimum Raceway Size: 3/4-inch trade size (DN 21)

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 INSTALLATION

A. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

B. Complete raceway installation before starting conductor installation.

C. Support raceways as specified in Division 26 Section "Hangers & Supports."

D. Install temporary closures to prevent foreign matter from entering raceways.

E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

F. Provide an additional one hundred feet of raceway and accessories of each type and size used on the project to accommodate any changes required to resolve interferences as directed by the Engineer.

G. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

H. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

I. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover.

1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
2. Space raceways laterally to prevent voids in concrete.
3. Run conduit larger than 1-inch trade size (DN 27) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
4. Change from nonmetallic tubing to Schedule 40 nonmetallic conduit, rigid steel conduit, or IMC before rising above the floor.

J. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.

1. Run parallel or banked raceways together on common supports.
2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

K. Join raceways with fittings designed and approved for that purpose and make joints tight.

1. Use insulating bushings to protect conductors.

L. Terminations:

1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

M. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

N. Telephone and Signal System Raceways, 2-Inch Trade Size (DN 53) and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet (45 m) and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements

O. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

P. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches (150 mm) above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

Q. Flexible Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

R. Provide five additional boxes (floor, junction, etc.) and accessories of each size and type used on the project to accommodate any changes required to resolve interferences as directed by the Engineer.

S. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.

T. Set floor boxes level and flush with finished floor surface.

U. Set floor boxes level. Trim after installation to fit flush with finished floor surface.

V. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.4 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 260533

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits and fittings, including GRC and PVC-coated steel conduit.
2. Rigid nonmetallic duct.
3. Flexible nonmetallic duct.
4. Duct accessories.
5. Polymer concrete handholes and boxes with polymer concrete cover.

1.2 DEFINITIONS

A. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.

B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.

C. Duct Bank:

1. Two or more ducts installed in parallel, with or without additional casing materials.
2. Multiple duct banks.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:

a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
b. Include duct entry provisions, including locations and duct sizes.
c. Include cover design.
d. Include grounding details.
e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.4 INFORMATIONAL SUBMITTALS

A. Duct and Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures. Drawings shall be signed and sealed by a qualified professional engineer.

B. Product Certificates: For concrete and steel used in precast concrete handholes, as required by ASTM C 858.

C. Source quality-control reports.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND FITTINGS

A. GRC: Comply with ANSI C80.1 and UL 6.

B. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2.2 RIGID NONMETALLIC DUCT

A. Underground Plastic Utilities Duct: Type EPC-40-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.

B. Acceptable Manufacturer:
1. ARNCO Corp
2. Cantex Inc.
3. Certain Teed Corp.
4. Condux Internations, Inc.
5. Crown Line Plastics
6. ElecSys, Inc.
7. Electri-Flex Co.
8. Lamson & Sesions
9. National Pipe & Plastics
10. Or equal

C. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

D. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 FLEXIBLE NONMETALLIC DUCTS

A. HDPE Duct: Type EPEC-40 HDPE, complying with NEMA TC 7 and UL 651A.
   1. ABB, Electrification Products
   2. ARNCO Corp.
   3. National Pipe & Plastics
   4. Premier Conduit
   5. Or equal

B. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2.4 DUCT ACCESSORIES

A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
   1. ABB, Electrification Products
   2. Allied Tube & Conduit
   3. Cantex Inc.
   4. IPEX USA LLC
   5. PenCell Plastics
   6. Underground Devices, Inc.
   7. Or equal

B. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."

2.5 POLYMER CONCRETE HANDHOLES AND BOXES WITH POLYMER CONCRETE COVER

A. Description: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.

B. Acceptable Manufacturers:
   1. Armorcast Products Co.
   2. MacLean Highline
   3. Oldcastle Infrastructure
   4. Quazite, Hubbell Inc. (Basis of Design)

C. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.

D. Color: Gray.

E. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.

F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.

G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

H. Cover Legend: Molded lettering, "ELECTRIC."

I. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.

J. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.

K. Handholes shall have factory-installed inserts for cable racks and pulling-in irons.

2.6 SOURCE QUALITY CONTROL

A. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
   1. Strength tests of complete boxes and covers shall be by an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
   2. Testing machine pressure gages shall have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Architect.

3.2 UNDERGROUND DUCT APPLICATION

A. Duct for Electrical Feeders 600 V and Less: RNC Type EPC-40-PVC, concrete-encased unless otherwise indicated.

B. Duct for Electrical Feeders 600 V and Less: RNC Type EPC-40-PVC, direct-buried unless otherwise indicated.

C. Duct for Electrical Branch Circuits: RNC Type EPC-40-PVC, direct-buried unless otherwise indicated.

D. Bored Underground Duct: Type EPEC-40 HDPE unless otherwise indicated.

E. Underground Ducts Crossing Paved Paths and Walks direct-buried unless otherwise indicated.

F. Underground Ducts Crossing: Driveways, Roadways and Railroads: RNC Type EPC-40 PVC, encased in reinforced concrete.

G. Stub-ups: Concrete-encased RNC and GRC.

3.3 EARTHWORK

A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restoration: Replace area immediately after backfilling is completed.

C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."

E. Cut and patch existing pavement in the path of underground duct, duct bank, and underground structures according to "Cutting and Patching" Article in Section 017300 "Execution."

3.4 DUCT AND DUCT-BANK INSTALLATION

A. Where indicated on Drawings, install duct, spacers, and accessories into the duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.

B. Install duct according to NEMA TCB 2.

C. Slope: Pitch duct a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from a high point between two manholes, to drain in both directions.

D. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 36” when used for Fiber Optic Cable, both horizontally and vertically, at other locations unless otherwise indicated.

E. Joints: Use solvent-cemented joints in duct and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent duct do not lie in same plane.

F. Installation Adjacent to High-Temperature Steam Lines: Where duct is installed parallel to underground steam lines, perform calculations showing the duct will not be subject to

environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.

G. End Bell Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) duct, and vary proportionately for other duct sizes.

H. Terminator Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use manufactured, cast-in-place duct terminators, with entrances into structure spaced approximately 6 inches (150 mm) o.c. for 4-inch (100-mm) duct, and vary proportionately for other duct sizes.

I. Building Wall Penetrations: Make a transition from underground duct to GRC at least 10 feet (3 m) outside the building wall, without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for RNC-to-GRC transition. Install GRC penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

J. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.

K. Pulling Cord: Install 200-lbf- (1000-N-) test nylon cord in empty ducts.

L. Concrete-Encased Ducts and Duct Bank:

1. Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes less than 6 inches (150 mm) in nominal diameter.
2. Width: Excavate trench 12 inches (300 mm) wider than duct on each side.
3. Width: Excavate trench 3 inches (75 mm) wider than duct on each side.
4. Depth: Install so top of duct envelope is at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
5. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
6. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per 20 feet (6 m) of duct. Place spacers within 24 inches (600 mm) of duct ends. Stagger spacers approximately 6 inches (150 mm) between tiers. Secure spacers to earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
7. Elbows: Use manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct unless otherwise indicated. Extend encasement throughout length of elbow.
8. Elbows: Use manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct run.
9. Reinforcement: Reinforce concrete-encased duct where crossing disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.

10. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
11. Concrete Cover: Install a minimum of 3 inches (75 mm) of concrete cover between edge of duct to exterior envelope wall, 2 inches (50 mm) between duct of like services, and 4 inches (100 mm) between power and communications ducts.
12. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
13. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.

M. Direct-Buried Duct and Duct Bank:

1. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inches (150 mm) in nominal diameter.
2. Width: Excavate trench 12 inches (300 mm) wider than duct on each side.
3. Width: Excavate trench 3 inches (75 mm) wider than duct on each side.
4. Depth: Install top of duct at least 18 inches (900 mm) below finished grade unless otherwise indicated.
5. Set elevation of bottom of duct bank below frost line.
6. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
7. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per 20 feet (6 m) of duct. Place spacers within 24 inches (600 mm) of duct ends. Stagger spacers approximately 6 inches (150 mm) between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
8. Elbows: Install manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct direction unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
9. Install manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct.
10. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches (100 mm) over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.

    a. Place minimum 3 inches (75 mm) of sand as a bed for duct. Place sand to a minimum of 6 inches (150 mm) above top level of duct.
    b. Place minimum 6 inches (150 mm) of engineered fill above concrete encasement of duct.

N. Underground-Line Warning Tape: Bury conducting underground line specified in Section 260553 "Identification for Electrical Systems" no less than 12 inches (300 mm) above all concrete-encased duct and duct banks and approximately 6” below grade. Align tape parallel to and within 3 inches (75 mm) of centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

3.5 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.

D. Install handholes and boxes with bottom below frost line, <Insert depth of frost line below grade at Project site> below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.

F. Field cut openings for duct according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

G. For enclosures installed in asphalt paving and brick masonry pavers and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.

1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Section 033000 "Cast-in-Place Concrete," with a troweled finish.
2. Dimensions: 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep).

3.6 GROUNDING

A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 12-inch- (300-mm-) long mandrel equal to duct size minus 1/4 inch (6 mm). If obstructions are indicated, remove obstructions and retest.
3. Test handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

C. Prepare test and inspection reports.

3.8 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump.

1. Sweep floor, removing dirt and debris.
2. Remove foreign material.

END OF SECTION 260543

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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

1.3 SUBMITTALS

A. Provide product data information on products used.

1.4 QUALITY 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 and service.

B. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear, weather- and chemical-resistant coating.

C. Pretensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.

D. Consider alternatives before specifying self-adhesive product in paragraph below. See Editing Instruction No. 1 in the Evaluations.

E. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide (0.08 mm thick by 25 to 51 mm wide).

F. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.

1. Not less than 6 inches wide by 4 mils thick (152 mm wide by 0.102 mm thick).
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend indicating type of underground line.

G. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

H. Aluminum, Wraparound Marker Bands: Bands cut from 0.014-inch- (0.4-mm-) thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.

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 (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.

C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for the application. 1/4-inch (6.4-mm) grommets in corners for mounting.

D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for the application. 1/4-inch (6.4-mm) grommets in corners for mounting.

E. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or 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 (5 mm).
2. Tensile Strength: 50 lb (22.3 kg) minimum.
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: According to color-coding.

B. Paint: Formulated for the type of surface and intended use.

1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.
2. Primer for Concrete Masonry Units: Heavy-duty-resin block filler.
3. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.

4. 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. Circuits with More Than 600 V: Identify raceway and cable with "DANGER--HIGH VOLTAGE" in black letters 2 inches (51 mm) high, stenciled with paint at 10-foot (3-m) intervals over a continuous, painted orange background. Identify the following:

1. Entire floor area directly above conduits running beneath and within 12 inches (305 mm) of a basement or ground floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to conduits concealed within wall.
3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in the building, or concealed above suspended ceilings.
4. Entire surface of exposed conduits.

F. Install painted identification according to manufacturer's written instructions and as follows:

1. Clean surfaces of dust, loose material, and oily films before painting.
2. Prime surfaces using type of primer specified for surface.
3. Apply one intermediate and one finish coat of enamel.

G. Color Banding Raceways and Exposed Cables: Band exposed and accessible raceways of the systems listed below:

1. Bands: Pretensioned, wraparound plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches (51 mm) wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
3. Apply the following colors to the systems listed below:
   a. Fire Alarm System: Red.
   b. Fire-Suppression Supervisory and Control System: Red and yellow.
   c. Combined Fire Alarm and Security System: Red and blue.

d. Security System: Blue and yellow.
e. Mechanical and Electrical Supervisory System: Green and blue.
f. Telecommunication System: Green and yellow.

H. 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.

I. Circuit Identification Labels on Boxes: Install labels externally.

1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
2. Concealed Boxes: Plasticized card-stock tags.
3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.

J. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches (400 mm) overall, use a single line marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.

K. Color-Coding of Secondary Phase Conductors: Use the following colors for service feeder, and branch-circuit phase conductors:

1. 208/120-V Conductors:
   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
2. 480/277-V Conductors:
   a. Phase A: Brown.
   b. Phase B: Orange.
   c. Phase C: Yellow
3. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:
   a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch- (25-mm-) wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
   b. Colored cable ties applied in groups of three ties of specified color to each wire at each terminal or splice point starting 3 inches (76 mm) from the terminal and spaced 3 inches (76 mm) apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.

L. Power-Circuit Identification: Metal tags or aluminum, wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and switchboard rooms.

1. Legend: 1/4-inch- (6.4-mm-) 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.

M. 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.

N. Apply warning, caution, and instruction signs as follows:

1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch- (9-mm-) high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

O. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, 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-inch- (13-mm-) high lettering on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high. Use white lettering on black 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. Disconnect switches.
6. Enclosed circuit breakers.
7. Motor starters.
8. Push-button stations.
9. Power transfer equipment.
10. Contactors.
11. Remote-controlled switches.
12. Control devices.
13. Transformers.
14. Power-generating units.
15. Telephone switching equipment.
16. Clock/program master equipment.
17. Fire alarm master station or control panel.

END OF SECTION 260553

SECTION 26 22-00 - LOW-VOLTAGE DRY TYPE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 SCOPE

A. Furnish and install dry type isolation transformers of the types, sizes and quantities indicated on the contract drawings. Provide all lugs, accessories and mounting hardware necessary for proper installation and operation.

B. It shall be the contractor's responsibility to confirm all existing and future access openings and proper ventilation to properly install the transformer in the designated locations. Should the contractor require any alterations to the building structure or require the dismantling of the transformer provided to meet this requirement the contractor shall provide this work at no additional cost.

1.2 RELATED DOCUMENTS

A. All drawings and general provisions of the Contract including General and Supplementary Conditions apply to this section.

1.3 SUBMITTALS

A. Provide product information prior to fabrication and installation. Product data shall include all dimensions, weights, electrical ratings, wiring diagrams and required clearances.

B. When requested, provide additional product data and certifications necessary to show conformance with this specification.

C. Provide information for record purposes including field test reports and maintenance data as required.

1.4 RELATED STANDARDS

A. Provide transformers in accordance with the following standards, where applicable:
   1. Underwriter's Laboratory 1561, Standard for Safety for Dry-Type General Purpose and Power Transformers
   2. Underwriter's Laboratory 506, Standard for Safety for Specialty Transformers
   3. NEMA ST 20, Dry Type Transformers for General Applications
   4. NEMA 250, Enclosures for Electrical Equipment (1000 V Max)
   5. ANSI / IEEE C57.12.91, Standard Test Code for Dry-Type Distribution and Power Transformers
   6. U.S. Department of Energy 10 CFR Part 431 Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule, dated April 18, 2013. These efficiency standards shall take effect January 1, 2016. All transformers covered in the scope of this document and this specification, manufactured after December 31, 2015, shall be compliant with the new standard.

B. Manufacturer Seismic Qualification: The low voltage general purpose dry type transformer (1000kVA max.) shall meet and be certified to seismic requirements specified in the IBC 2009 International Building Code.
   1. The low voltage general purpose dry type transformer shall be complaint with IBC 2009 parameters.
      a. Ip – Importance Factor: 1.5 – Components must function after an earthquake for life safety purposes (Building Occupancy Code IV).

b. Sds – For ventilated transformers Sds is <=2.00g as standard up to 1000kVA. Encapsulated transformers Sds is 2.00g
c. z/h – Height factor ratio: 1.00 Note: Ratio is a calculated value equal to the floor the gear is installed on divided by 12. A 6th floor installation is a 0.5 value. A basement or ground floor installation is a 0.0 value.

2. Equipment shall be designed to be located in a concrete and steel, moment-resisting frame building not exceeding 12 stories in height with a minimum story height of 10 feet.]

1.5 QUALITY ASSURANCE

A. Manufacturer shall have produced similar electrical equipment for a minimum period of 10 years.

B. Products shall be listed by Underwriters Laboratories, Inc.

1.6 DELIVERY, STORAGE AND HANDLING

A. Handle transformers in accordance manufacturer's recommendations. Utilize factory provisions for all lifting, rigging, or hoisting.

B. Store transformers prior to installation in a temperature and humidity controlled space. If such a space is not available, apply temporary heat in accordance with the manufacturer's instructions within each ventilated type transformer case to exclude moisture and condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The low voltage, dry type transformer(s) shall be supplied by Siemens or pre-approved equal. Approved manufacturers are as follows:
1. Siemens
2. Square D
3. Cutler Hammer
4. General Electric
5. Or equal

B. Transformers specified in this Section and power distribution equipment feeding and being fed by the transformers shall be warranted and serviced by the same manufacturer. Manufacturer shall have a local field service organization available on an as needed basis.

2.2 GENERAL REQUIREMENTS

A. Transformers shall be of the general purpose, self cooled, two winding, dry type designed for 60 Hz operation. Transformers shall be designed, manufactured and tested in accordance with the latest ANSI, NEMA and IEEE Standards and shall be listed and labeled in accordance with UL 1561.

B. Insulation System
1. Transformers 15 KVA and larger shall be of the ventilated type and have a UL recognized 220°C insulation system. The temperature ratings shall be based on an allowable 115°C winding temperature rise above a 30°C hot spot and 40°C ambient.
2. Transformer design KVA rating shall be suitable for a 30°C average, 40°C maximum ambient temperature.

C. Core And Coil

1. Core construction shall be of non-aging electrical grade grain-oriented silicon steel with high permeability, low hysteresis and low eddy current losses as needed to achieve these efficiency levels. Core laminations shall be tightly assembled and magnetic flux densities shall be kept well below the saturation point.
2. Windings shall be wound of high quality aluminum.
3. Ventilation of windings shall be accomplished by insulated spacers installed and arranged to brace coil layers and provide maximum ventilation. Core and coil assemblies shall be constructed to provide short circuit withstand capability as defined by ANSI and NEMA standards. The complete assembly shall be installed on vibration dampening pads to reduce noise and securely bolted to the enclosure base. A flexible grounding conductor shall be installed between the core and coil assembly and the transformer enclosure.
4. Core and coil sealing process:
    a. The complete core and coil assembly shall be impregnated with non-hydroscopic thermo-setting polyester varnish to provide a high dielectric and flame retardant seal.
    b. The shield of varnish to the coils shall effectively impregnate the entire core and coil assembly that results in a unit which is virtually impermeable to moisture, dust, dirt, salt air, other industrial contaminants and provide high dielectric seal as well as fungus resistant.
5. Core lamination clamping angle shall be of adequate thickness and hardness to insure a tight and rigid core assembly to eliminate movement of core plates. Welded core designs shall include multiple beads as necessary to insure a tight and rigid core assembly to eliminate core plate movement.
6. Provide full capacity taps in the high-voltage windings as follows:
    a. 15 KVA through 500 KVA step-down transformers: 2 – 2½ % full capacity above normal and 4 – 2½ % full capacity below normal.
    b. 750 KVA and above step-down transformers: 2 – 2½ % full capacity above normal and 2 – 2½% full capacity below normal.
    c. Step-up and dual primary transformers: Provide NEMA standard taps.

D. Enclosures
1. Ventilated enclosures shall be of heavy gauge steel construction of NEMA 3R construction for outdoor use with the addition of weather shields. Front and rear covers shall be removable to provide access to terminal compartment(s). Terminals shall be fully sized to carry the transformer full load current and shall be arranged to accept UL listed cable connectors.
2. Enclosure wiring space and positioning of terminals shall allow for adequate cable bending space.
3. Finish enclosures in ANSI 61 gray paint.
4. Each transformer shall have a securely attached nameplate providing complete electrical ratings, wiring diagram, tap connections and catalog number, as applicable.

E. Sound
1. Unless otherwise specified, sound levels shall be in accordance with values allowed by NEMA ST-20.

F. Accessories
1. Provide weather shields for ventilated transformers installed outdoors conforming to the requirements of NEMA 250, Type 3R All insulating materials are to exceed NEMA ST20 standards and be rated for 220ºC UL component recognized insulation system.

2.3 PACKAGED PANELBOARD AND TRANSFORMER

A. Transformers 15kVA and larger shall be 150ºC temperature rise above 40ºC ambient. Transformers 25kVA and larger shall have a minimum of 4 - 2.5% full capacity primary taps. Exact voltages and taps to be as designated on the plans or the transformer schedule.
B. The maximum temperature of the top of the enclosure shall not exceed 50ºC rise above a 40ºC ambient.
C. Transformers shall be low loss type with minimum efficiencies per NEMA TP1 when operated at 35% of full load capacity. Efficiency shall be tested in accord with NEMA TP2.
D. The transformer(s) shall be rated as indicated in the following schedule:
Identification Number(s)
kVA Rating
Voltages
Phase
Frequency

2.3.1 CONSTRUCTION

A. Transformers are to be encapsulated using a sand-epoxy resin mixture to provide maximum protection against moisture, dust and corrosive environments.
B. All cores to be constructed with low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point to prevent core overheating.
C. The core of the transformer shall be grounded to the enclosure by means of a grounding conductor sized in accordance with applicable UL and NEC standards.
D. The packaged panelboard and transformer enclosures shall be fabricated of heavy gauge, sheet steel construction. The entire enclosure shall be finished utilizing a continuous process consisting of degreasing, cleaning and phosphatizing, followed by electrostatic deposition of polymer polyester powder coating and baking cycle to provide uniform coating of all edges and surfaces. The coating color shall be ANSI 49.
E. All transformers shall have a minimum 2-5% full capacity primary taps below normal and shall be rated 115°C temperature rise above 40°C maximum ambient. All insulating aterials shall be in accordance with current ANSI C89.2 and NEMA ST20 standards for a 185°C UL component recognized insulation system.
F. Packaged power supplies shall include integrally mounted and wired primary and secondary main circuit breakers in accordance with the National Electrical Code requirements.
G. Branch circuit breakers shall be Square D Type QO QWIK-GARD or equal. All breakers shall be plug-in type. Trip indication shall be clearly shown by the breaker handle taking position between ON and OFF when the breaker is tripped and the VISI-TRIP indication consisting of a highly visible red tripped circuit indication.
H. A hinged access door shall be provided which maintains itself in the open position when desired, and which has padlock provisions.
I. The packaged transformer and panelboard shall constructed as separate enclosures capable of being assembled or disassembled as independent units.

2.3.2 SOUND LEVELS

A. Sound levels shall be warranted by the manufacturer not to exceed the following: 5 to 50KVA - 45dB.

2.3.3 OPTIONAL ACCESSORIES

A. Provide weather shields for units installed in damp or wet locations.
B. Provide wall mounting brackets as required for space compliance for units.

1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install per manufacturer’s recommendations and contract documents.

B. Install units plumb, level and rigid without distortion

3.2 ADJUSTMENTS AND CLEANING

A. On completion of installation, inspect components. Remove paint splatters and other spots, dirt and debris. Repair scratches and mars on finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

B. Adjust transformer taps to provide optimum voltage conditions at utilization equipment throughout normal operating cycle of facility. Record primary and secondary voltages and tap settings and submit with test results.

3.3 TESTING

A. Include the following minimum inspections and tests according to manufacturer's written instructions. Comply with IEEE C57.12.91 for test methods and data correction factors.

B. Inspect accessible components for cleanliness, mechanical and electrical integrity and damage or deterioration. Verify that temporary shipping bracing has been removed. Include internal inspection through access panels and covers.

C. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, if not available, those specified in UL 486A and UL 486B.

3.4 WARRANTY

A. Equipment manufacturer warrants that all goods supplied are free of non-conformities in workmanship and materials for one year from date of initial operation, but not more than eighteen months from date of shipment.

END OF SECTION

SECTION 262416 – PANELBOARDS & SWITCHBOARDS

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 panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:

1. Lighting and appliance branch-circuit panelboards.
2. Distribution switchboards.
3. Transient voltage surge suppressor panelboards.

B. Related Sections include the following:

1. Division 26 Section "Fuses."

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.

F. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, switchboard, overcurrent protective device, TVSS device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard, switchboard 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. UL listing for series rating of installed devices.
e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

C. Field Test Reports: Submit written test reports and include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Panelboard and Switchboard Schedules: For installation in panelboards. Submit final versions after load balancing.

E. Maintenance Data: For panelboards and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Contract Closeout," 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.

F. Should the contractor submit any substitution (including other approved manufacturers) other than the specified product the contractor shall be responsible for all electrical, mechanical, structural, and architectural revisions as required to accommodate the installation of the substituted equipment at no additional cost to the owner.

1.5 QUALITY ASSURANCE

A. Comply with NEMA PB 1.

B. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of switchboards, panelboards and associated 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.

1.7 EXTRA MATERIALS

A. Keys: Four spares of each type of panelboard cabinet lock. Key all cabinets alike.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:

a. Eaton Corp.; Cutler-Hammer Products.
b. Schneider Electric - Square D Co. (Basis of Design)
c. General Electric
d. Or equal

2.2 FABRICATION AND FEATURES

A. Enclosures: Flush- and surface-mounted cabinets as noted on the drawings. NEMA PB 1, Type 1, to meet environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 3R.

B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

C. Hinged Front Cover: For boxes more than 28 inches high, entire front trim hinged to box and with standard door within hinged trim cover.

D. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.

E. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.

F. Bus: Hard-drawn copper, 98 percent conductivity.

G. Main and Neutral Lugs: Mechanical type suitable for use with conductor material.

H. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

I. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.

J. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

K. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.

L. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads as noted on the drawings.

M. Split Bus: Vertical buses divided into individual vertical sections.

N. Gutter Barrier: Arrange to isolate individual panel sections.

O. Feed-through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device. Provide wire feed same size as feeder.

P. Provide ARC Flash labeling as required by the National Electrical Code.

2.3 PANELBOARD SHORT-CIRCUIT RATING

A. UL label indicating series-connected rating with integral or remote upstream devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.

B. Fully rated to interrupt symmetrical short-circuit current available at terminals.

C. Contractor shall confirm from local utility company prior to submittal review of minimum symmetrical short circuit rating requirements within project site, should the contract documents differ the contractor shall submit and provide the greater rated value.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

C. All panelboards shall be fully equipped with all branch breaker mounting assemblies.

D. All panelboards shall be fully equipped with a grounding bus bar assembly which must be large enough to meet a minimum of 100% of the branch circuit quantities plus 10%.

E. All panelboards shall be fully equipped with a neutral bus bar assembly which must be large enough to meet a minimum of 100% of the branch breaker quantities plus 10%.

2.5 CLASS 2 LIGHTING PANELS – WITH CONTROL SYSTEM

Lighting Control System

A. The lighting control system shall consist of microprocessor-based control electronics with remotely operated circuit breakers mounted to a UL67 listed lighting panelboard interior and enclosed in a UL50 listed panelboard enclosure. The circuit breakers shall provide overcurrent protection, and have an AIR rating or series connected rating that meets or exceeds the fault current of the system to which the panelboard is being applied.

B. Each master control panel shall meet or exceed the following capabilities:

1. Sixteen (16) 2-wire input terminals for connection to external low voltage switch contacts.

2. Time of day scheduling to automatically shut off lighting at specific programmed times

3. Direct control of branch circuits in a master/slave sub-net configuration.
4. Provide true status feedback by monitoring branch circuit breaker status based on actual system voltage at load side terminal.
5. Accept remote commands through the facilities Ethernet infrastructure.

C. All lighting control components shall be installed in a conventional panelboard 20 inches wide or column-width enclosures (as noted on drawings). Suitable barriers shall be installed to separate Class 2 wiring from power conductors.

2.6 DISTRIBUTION SWITCHBOARDS

A. Doors: Front mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike. Door-in-door construction.

B. Main Overcurrent Protective Devices: Circuit breaker as noted. Main lugs only unless otherwise noted.

C. Branch overcurrent protective devices shall be one of the following:

1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.7 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. 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.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.

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 material of conductors.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for ALL heating, air-conditioning, and refrigerating equipment.
3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
4. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
5. Auxiliary Switch: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

6. Lock-on clips: Install on circuit breakers for alarm, telecommunications, control systems, and refrigeration equipment.
7. Shunt Trip Device: Integrally mounted relay and trip unit with manual reset ONLY. In addition to the designated locations indicated on the contract documents it shall be required to provide a shunt trip device for any/all elevator and escalator equipment and systems. All elevator and escalator shunt trip devices shall be installed per the ASME A17.1 Safety Code for Elevators and Escalators..

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Mounting Heights: Top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.

C. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

D. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

E. Install filler plates in unused spaces.

F. Provide ONE additional panelboard and accessories of each size and type used on the project to accommodate changes required to resolve interferences or as directed by the Engineer.

G. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

H. Wiring in Panelboard Gutters: Arrange conductors 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 16 Section "Electrical Identification."

B. Panelboard Nameplates: Label each panelboard with engraved laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

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. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test indicated 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. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:

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 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.6 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 the 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 Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes receptacles, connectors, switches, and finish plates.

1.3 DEFINITIONS

A. GFCI or GFI: Ground-Fault Circuit Interrupter.

B. SPD: Surge Protection Device

C. TVSS: Transient Voltage Surge Suppressor.

1.4 SUBMITTALS

A. Product Data: For each product specified.

B. Shop Drawings: Legends for receptacles and switch plates.

C. Samples: For devices and device plates for color selection and evaluation of technical features.

D. Maintenance Data: For materials and products to include in maintenance manuals specified in Division 1.

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.

B. Comply with NEMA WD 1.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

1.7 EXTRA MATERIALS

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

1. Floor Service-Outlet Assemblies: One for each 20, but not less than one.
2. Toggle switches with occupancy sensors: One for each five installed but not less than two.
3. TVSS Receptacles: One for each eight installed, but not less than two.

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. Wiring Devices:

a. Hubbell, Inc.; Wiring Devices Div.
b. Killark Electric Manufacturing Co.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand; Wiring Devices Div.

2. Wiring Devices for Hazardous (Classified) Locations:

a. Crouse-Hinds Electrical Co.; Distribution Equipment Div.
b. Killark Electric Manufacturing Co.
c. Pyle-National, Inc.; an Amphenol Co.

3. Multioutlet Assemblies:

a. Airey-Thompson Co.
b. Legrand/Wiremold Division.

2.2 RECEPTACLES

A. Straight-Blade (tamper resistant) and Locking Receptacles: Heavy-Duty grade.

B. GFCI Receptacles: Feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle arranged to protect connected downstream receptacles on

same circuit. Design units for installation in a 2-3/4-inch- (70-mm-) deep outlet box without an adapter.

C. Isolated-Ground Receptacles: Equipment grounding contacts connected only to the green grounding screw terminal of the device with inherent electrical isolation from mounting strap.

1. Devices: Listed and labeled as isolated-ground receptacles.
2. Isolation Method: Integral to receptacle construction and not dependent on removable parts.

D. TVSS Receptacles: Duplex type, NEMA WD 6, Configuration 5-20R, with integral TVSS in line to ground, line to neutral, and neutral to ground.

1. TVSS Components: Multiple metal-oxide varistors; rated a nominal clamp level of 500 transient-suppression voltage and minimum single transient pulse energy dissipation of 140 J line to neutral, and 70 J line to ground and neutral to ground.
2. Active TVSS Indication: Light visible in face of device to indicate device as "active" or "no longer active."
3. Identification: Distinctive marking on face of device denotes TVSS-type unit.

E. Industrial Heavy-Duty Receptacle: Comply with IEC 309-1.

F. Hazardous (Classified) Location Receptacles: Comply with NEMA FB 11.

2.3 PENDANT CORD/CONNECTOR DEVICES

A. Description: 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.

2.4 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with type SOW-A jacket. Green-insulated grounding conductor, and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.5 CORD REELS

A. A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with type SOW-A jacket. Green-insulated grounding conductor, and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: GFCI type device, Nylon body. Match cord and receptacle type for connection
3. Reel: 15 Amp rated, 125V, with 25 linear feet of retractable cable (Hubbell model #HBL45123C). Provide mounting assembly as required for complete installation.

2.6 SWITCHES

A. Snap (toggle) Switches: Heavy-duty, quiet type (single, 3-way and 4-way).

1. Switch: 20 A, 120/277-V ac.

2. Switch with occupancy sensing: 20 A, 120/277-V ac. Passive infrared compaitable with LED and CFL lamps, adjustable time delay of 20 seconds to 30 minutes, 0 – 1000 watt lighting control, manual by-pass control.

3.1 WALL PLATES

A. Single and combination types match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.

2. Material for Finished Spaces: 0.04-inch- (1-mm-) thick, Type 302, satin-finished stainless steel.

3. Material for Unfinished Spaces: Galvanized steel.

3.2 MULTIOUTLET ASSEMBLIES

A. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

B. Raceway Material: Metal, with manufacturer's standard finish.

C. Raceway Material: Nonmetal.(accepted in office areas only)

D. Wire: No. 12 AWG.

3.3 FLOOR BOXES FOR ON-GRADE AND ABOVE-GRADE CONCRETE FLOORS

1 Configurations: Boxes shall be available in one-, two-, or three-gang configurations or a single unit with two to eleven independent wiring compartments and available in stamped steel, epoxy coated stamped steel, nonmetallic and cast iron versions. Boxes shall be available in deep and shallow versions. Boxes shall provide pre- and post-pour adjustments. Multiple gang boxes shall also provide a removable barrier between the individual compartments for greater capacity when required. Refer to Drawings for size and types.

a. Acceptable Product: Resource RFB4 Series Boxes for Concrete Floors by Legrand/Wiremold.

b. Acceptable Product: Resource RFB4E-OG Series Shallow Epoxy Coated Stamped Steel Floor Boxes for Concrete Floors by Legrand/Wiremold.

2 Cover:

a. Acceptable Product: FloorPort FPCT, FPBT, and FPFFT Series Covers: Manufactured of die-cast aluminum or die-cast zinc, and available in brushed aluminum finish and powder-coated paint finishes (black, gray, bronze, nickel and brass). Activation covers shall be available in flanged and flangeless versions. Covers shall be available with options for tile or carpet inserts, or flush covers. The cover's hinge shall allow for the cover to open 180 degrees. The furniture feed covers shall come equipped with one 1 inch (25 mm) trade size screw plug opening and one combination 1-1/4 inches (32 mm) and 2 inches (52 mm) trade size screw plug.

1) Flanged covers shall be 7-3/4 inches L by 6-9/16 inches W (197 mm by 167 mm).

2) Flangeless covers shall be 6-3/4 inches L by 5-9/16 inches W (171 mm by 142 mm).

3 Metallic Floor Boxes:

a. Material: Stamped steel and painted with a fusion-bonded epoxy; box interior and exterior painted; 1-3/8 inches (35 mm) pre-pour adjustment; 3/4 inch (19 mm) post-pour adjustment.

b. Material: Epoxy coated cast iron; box interior and exterior painted; 1-3/4 inches (44 mm) pre-pour adjustment; 1/2 inch (13 mm) post-pour adjustment.

c. Box Type: Rectangular.

d. Service: Multiple.

3.4 MISCELLANEUOS WIRING CONNECTIONS AND COMPONENTS

A. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

B. Raceway Material: Metal, with manufacturer's standard finish.

C. Raceway Material: Nonmetal.(accepted in office areas only)

D. Wire: not less than the manufacturers recommendation unless noted otherwise.

E. Security Devices: Provide all wiring devices and connections as specified by the manufacturer and the contract documents. Unless otherwise noted.

F. IT Devices: Provide all wiring devices and connections as specified by the manufacturer and the contract documents. Unless otherwise noted.

G. Audio Visual Devices: Provide all wiring devices and connections as specified by the manufacturer and the contract documents Unless otherwise noted.

3.5 FINISHES

A. Color: Manufacturers standard, as selected by Architect.

PART 3 - EXECUTION

4.1 INSTALLATION

A. Install devices and assemblies plumb and secure.

B. Install wall plates when painting is complete.

C. Install wall dimmers to achieve indicated rating after derating for ganging as instructed by manufacturer.

D. All receptacles used for garage installations shall be GFIC type wiring devices.

E. Do not share neutral conductor on load side of dimmers.

F. Provide ten additional wiring devices (receptacles, TVSS, wallplates, switches, etc.) and accessories of each size and type used on the project to accommodate any changes required to resolve interfereces.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Protect devices and assemblies during painting.

I. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit arrangement of partitions and furnishings.

4.2 IDENTIFICATION

A. Comply with Division 16 Section "Electrical Identification."

B. Comply with Division 16 Section "Basic Electrical Materials and Methods."

1. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.
2. Receptacles: Identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes.

4.3 CONNECTIONS

A. Connect wiring device grounding terminal to outlet box with bonding jumper.

B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.

C. Isolated-Ground Receptacles: Connect to isolated-ground conductor routed to designated isolated equipment ground terminal of electrical system.

D. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

4.4 FIELD QUALITY CONTROL

A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.

B. Check TVSS receptacle indicating lights for normal indication.

C. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

D. Replace damaged or defective components.

4.5 CLEANING

A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:

a. Control circuits.
b. Motor-control centers.
c. Panelboards.
d. Switchboards.
e. Enclosed controllers.
f. Enclosed switches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bussmann, by Eaton
2. Edison
3. Littlefuse, Inc.
4. Mersen USA

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Type RK-1: 250-V, zero- to 600-A rating, 200 kAIC, time delay.
2. Type RK-5: 250-V, zero- to 600-A rating, 200 kAIC, time delay.
3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, fast acting.

4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC, fast acting.
5. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
6. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.
7. Type T: 600-V, zero- to 1200-A rating, 200 kAIC, very fast acting.

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 NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Owner.

3.2 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes individually mounted enclosed switches and circuit breakers used for the following:

1. Service disconnecting means.
2. Feeder and branch-circuit protection.
3. Motor and equipment disconnecting means.

B. Related Sections include the following:

1. Division 262726 Section "Wiring Devices" for attachment plugs, receptacles, and toggle switches used for disconnecting means.
2. Division 262416 Section "Panelboards and Switchboards" for individually enclosed, fusible switches used as feeder protection.
3. Division 262813 Section "Fuses" for fusible devices.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. RMS: Root mean square.

C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each switch and circuit breaker.

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. 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. Current and voltage ratings.
c. Short-circuit current rating.

d. UL listing for series rating of installed devices.
e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

C. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.

D. Field Test Reports: Submit written test reports and include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Manufacturer's field service report.

F. Maintenance Data: For enclosed switches and circuit breakers and for components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Closeout Procedures," include the following:

1. Routine maintenance requirements for components.
2. Manufacturer's written instructions for testing and adjusting switches and circuit breakers.
3. Time-current curves, including selectable ranges for each type of circuit breaker.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA AB 1 and NEMA KS 1.

D. Comply with NFPA 70.

E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 EXTRA MATERIALS

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

1. Spares: For the following:

   a. Potential Transformer Fuses-Provide an additional 6 fuses of each type utilized on this project.
   b. Control-Power Fuses-Provide an additional 6 fuses of each type utilized on this project.
   c. Fuses and Fusible Devices for Fused Circuit Breakers-Provide an additional 6 fuses of each type utilized on this project.
   d. Fuses for Fused Switches-Provide an additional 10 fuses of each type utilized on this project.
   e. Fuses for Fused Power-Circuit Devices-Provide an additional 10 fuses of each type utilized on this project.

2. Spare Indicating Lights-Provide an additional 6 lights of each type utilized on this project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Fusible Switches:

    a. Eaton Corp.; Cutler-Hammer Products.
    b. General Electric Co.; Electrical Distribution & Control Division.
    c. Siemens Energy & Automation, Inc.
    d. Square D Co.

2. Molded-Case Circuit Breakers:

    a. Eaton Corp.; Cutler-Hammer Products.
    b. General Electric Co.; Electrical Distribution & Control Division.
    c. Klockner-Moeller.
    d. Siemens Energy & Automation, Inc.
    e. Square D Co.

3. Combination Circuit Breaker and Ground-Fault Trip:

    a. Eaton Corp.; Cutler-Hammer Products.
    b. General Electric Co.; Electrical Distribution & Control Division.
    c. Siemens Energy & Automation, Inc.
    d. Square D Co.

4. Molded-Case, Current-Limiting Circuit Breakers:

    a. Eaton Corp.; Cutler-Hammer Products.
    b. General Electric Co.; Electrical Distribution & Control Division.
    c. Siemens Energy & Automation, Inc.
    d. Square D Co.

5. Integrally Fused, Molded-Case Circuit Breakers:

    a. Eaton Corp.; Cutler-Hammer Products.
    b. General Electric Co.; Electrical Distribution & Control Division.
    c. Siemens Energy & Automation, Inc.
    d. Square D Co.

2.2 ENCLOSED SWITCHES

A. Enclosed, Nonfusible Switch: NEMA KS 1, Type HD, minimum 600V rated, with lockable handle.

B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, minimum 600V rated, with clips to accommodate specified fuses, lockable handle with two padlocks, and interlocked with cover in closed position.

2.3 ENCLOSED CIRCUIT BREAKERS

A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. 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.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; 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.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
6. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.
7. Molded-Case Switch: Molded-case circuit breaker without trip units.

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 material of conductors.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
4. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system.
5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
7. Auxiliary Switch: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b"contacts operate in reverse of circuit-breaker contacts.

8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
9. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

2.4 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

2.5 FACTORY FINISHES

A. Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested enclosures before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

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

3.2 INSTALLATION

A. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

B. Provide an additional four branch breakers with enclosures and accessories of each size, phase and voltage as required to accommodate changes to resolve interferences or as directed by the Engineer.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 260500 Section "Basic Electrical Materials and Methods"

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.4 CONNECTIONS

A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.

B. Install power wiring. Install wiring between switches and circuit breakers, and control and indication devices.

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.

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each enclosed switch, circuit breaker, component, and control circuit.
2. Test continuity of each line- and load-side circuit.

B. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test indicated 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. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Open or remove doors or panels so connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each unit 11 months after date of Substantial Completion.
2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. Record of Infrared Scanning: Prepare a certified report that identifies switches and circuit breakers checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 **ADJUSTING**

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.7 **CLEANING**

A. On completion of installation, inspect interior and exterior of 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 263213 – DIESEL GENERATOR SETS

PART 1 - GENERAL

1.1 SCOPE

A. Provide complete factory assembled generator set equipment with digital (microprocessor-based) electronic generator set controls, digital governor, and digital voltage regulator.

B. Rebranding and OEM (original equipment manufacturer) agreements: Only equipment manufactured by the listed OEM manufacturers will be acceptable. Units that are manufactured by others and rebranded will NOT be acceptable for this contract and will be rejected. Letters from OEM stating that re-branded units are “equal” shall be rejected.

C. Provide factory test, startup by a supplier authorized by the equipment manufacturer(s), and on-site testing of the system.

D. The generator set manufacturer shall warrant all equipment provided under this section, whether or not it is manufactured by the generator set manufacturer, so that there is one source for warranty and product service.

E. This specification is not a performance specification. Any/all suggested manufacturer substitutions the contractor elects to submit to the engineer MUST be fully 100% equal to or better than that specified or the product will be rejected. This includes all equipment components such as but not limited to: dip ratios, horsepower, torque, capacity, cubic inch engine size, alternator, charger, coolant system, etc.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

A. This Section includes packaged engine-generator sets suitable for use in mission critical applications with the features as specified and indicated. Engine generators will be used as the Standby power source for the system, but shall be capable of providing reliable power with no run-time limitations while the primary source of power is unavailable.

1.4 DEFINITIONS

A. Emergency Standby Power (ESP): Per ISO 8528: The maximum power available during a variable electrical power sequence, under the stated operating conditions, for which a generating set is capable of delivering in the event of a utility power outage or under test conditions for up to 200 hours of operation per year with the maintenance intervals and procedures being carried out as prescribed by the manufacturers. The permissible average power output (Ppp) over 24 hours of operation shall not exceed 70 percent of the ESP unless otherwise agreed by the RIC engine manufacturer.

B. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Thermal damage curve for generator.

2. Time-current characteristic curves for generator protective device.

3. Sound test data, based on a free field requirement.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, and location and size of each field connection.

1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.

2. Wiring Diagrams: Control interconnection, Customer connections.

C. Sizing Report

1. Calculated performance based on loads shown on one line

D. Certifications:

1. Submit statement of compliance which states the proposed product(s) is certified to the emissions standards required by the location for EPA, stationary emergency application.

1.6 INFORMATIONAL SUBMITTALS

A. Source quality-control test reports.

1. Certified summary of prototype-unit test report. See requirements in Part 2 "Source Quality Control" Article Part A. Include statement indicating torsional compatibility of components.

2. Certified Test Report: Provide certified test report documenting factory test per the requirements of this specification, as well as certified factory test of generator set sensors per NFPA110 level 1.

3. List of factory tests to be performed on units to be shipped for this Project.

4. Report of exhaust emissions and compliance statement certifying compliance with applicable regulations.

B. Warranty:

1. Submit manufacturer's warranty statement to be provided for this Project.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 2 hours of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

D. Comply with NFPA 37 (Standard For the Installation and Use of Stationary Combustion Engines and Gas Turbines).

E. Comply with NFPA 70 (National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702).

F. Comply with NFPA 110 (Emergency and Standby Power Systems) requirements for Level 1 emergency power supply system.

1.8 PROJECT CONDITIONS

A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: 0.0 deg C (32.0 deg F) to 40.0 deg C (104.0 deg F).

2. Relative Humidity: 0 to 95 percent.

3. Altitude: Sea level to 200.0 feet (60.96 m).

1.9 WARRANTY

A. Extended Warranty: Manufacturer shall provide extended coverage of 5 years from date of registered commissioning and start-up. Warranty shall be full comprehensive.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Only approved manufacturers shall supply equipment provided under this contract. Equipment specifications for this project are based on generator sets manufactured by Cummins Power Generation with microprocessor-based controls.

B. Proposals for substitutions must include a line by line compliance statement based on this specification in a hard copy formal written submission provided only by the 'bidding

contractor' (those that have purchased the contract documents). Note: This does not ensure the approval of the product. No manufacturer sales representatives requesting approval will be reviewed.

Other acceptable manufacturers listed below will be considered however must comply with the specification in its entirety (no exception).

a. Cummins Power (Onan) Basis of Design
b. Caterpillar

2.2 ENGINE-GENERATOR SET

A. Provide Cummins model DQDAA (C250D6) factory-assembled and -tested, engine-generator set.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.

1. Rigging Information: Indicate location of each lifting attachment, generator-set center of gravity, and total package weight in submittal drawings. All lifting access points shall be crane ready.

C. Capacities and Characteristics:

1. Power Output Ratings: Electrical output power rating for Standby operation of not less than 250.0kW, at 80 percent lagging power factor, 120/208, Three phase, 4 -wire, 60 hertz.

2. Alternator shall be capable of accepting maximum 1028 kVA in a single step and be capable of recovering to a minimum of 90% of rated no load voltage. Following the application of the specified kVA load at near zero power factor applied to the generator set.

3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component. The engine-generator nameplate shall include information of the power output rating of the equipment.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 0.5 percent of rated output voltage from no load to full load.

2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 2.1 seconds. On application of a 100% load step the generator set shall recover to stable voltage within 3 seconds.

3. Steady-State Frequency Operational Bandwidth: 0.25 percent of rated frequency from no load to full load.

4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

5. Transient Frequency Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within 2.6 seconds. On application of a 100% load step the generator set shall recover to stable frequency within 4 seconds.

6. Output Waveform: At full load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for any single harmonic. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50.

7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 8 seconds without damage to generator system components. For a 1-phase, bolted short circuit at system output terminals, system shall regulate both voltage and current to prevent over-voltage conditions on the non-faulted phases.

8. Start Time: Comply with NFPA 110, Level 1, Type 10, system requirements.

9. Ambient Condition Performance: Engine generator shall be designed to allow operation at full rated load in an ambient temperature under site conditions, based on highest ambient condition. Ambient temperature shall be as measured at the air inlet to the engine generator for enclosed units, and at the control of the engine generator for machines installed in equipment rooms.

2.3 ENGINE

A. Provide Cummins model QSL9 – G7 in line 6 cylinder

B. Minimum displacement of 543CU

C. Minimum BHP of 464

D. Fuel: ASTM D975 #2 Diesel Fuel

E. Rated Engine Speed: 1800RPM.

F. Lubrication System: The following items are mounted on engine or skid:

1. Lube oil pump: shall be positive displacement, mechanical, full pressure pump.

2. Filter and Strainer: Provided by the engine manufacturer of record to provide adequate filtration for the prime mover to be used.

3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

G. Engine Fuel System: The engine fuel system shall be installed in strict compliance to the engine manufacturer's instructions

H. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.

I. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity and performance.

1. Designed for operation on a single 120/240 VAC, 1500W Single phase, 60Hz power connection. Heater voltage shall be shown on the project drawings.

2. Installed with isolation valves to isolate the heater for replacement of the element without draining the engine cooling system or significant coolant loss.

3. Provided with a 24VDC thermostat, installed at the engine thermostat housing

J. Governor: Adjustable isochronous, with speed sensing. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate as appropriate to the state of the engine generator. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous states.

K. Cooling System: Closed loop, liquid cooled

1. Provide a 50C ambient design set mounted radiator cooling system

2. The generator set manufacturer shall provide prototype test data for the specific hardware proposed demonstrating that the machine will operate at rated standby load in an outdoor ambient condition of 40 deg C.

3. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.

4. Size of Radiator overflow tank: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.

5. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.

6. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

L. Muffler/Silencer: Selected with performance as required to meet sound requirements of the application, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements. For generator sets with outdoor enclosures the silencer shall be inside the enclosure. Exhaust noise shall be included in the enclosure sound data report

1. Installing contractor shall extend the exhaust pipe to above the roof (+/- 24′ AFG) it will go approximately 12 feet horizontally to reach the wall the total length of pipe would be 12 ft horizontal and 16 ft vertical with (2) 90 deg. & (1) 45 deg. elbows.

2. Exhaust extension shall be supported independent of the generator factory supplied exhaust system and enclosure. Piping shall be sized to ensure maximum engine back pressure is not exceeded.

M. Air-Intake Filter: Engine-mounted air cleaner with replaceable dry-filter element and restriction indicator.

N. Starting System: 24V as recommended by the engine manufacturer; electric, with negative ground.

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.

2. Cranking Cycle: As required by NFPA 110 for level 1 systems.

3. Battery Cable: Size as recommended by engine manufacturer for cable length as required. Include required interconnecting conductors and connection accessories.

4. Battery Compartment: Factory fabricated of metal with acid-resistant finish.

5. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation. The battery charging alternator shall have sufficient capacity to recharge the batteries with all parasitic loads connected within 4 hours after a normal engine starting sequence.

6. Battery Chargers: Unit shall comply with UL 1236, 12A 24VDC provide fully regulated, constant voltage, current limited, battery charger for each battery bank. It will include the following features:

a. Operation: Equalizing-charging rate based on generator set manufacturer′s recommendations shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.

b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 20 deg C to plus 40 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.

c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.

d. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.

e. Provide LED indication of general charger condition, including charging, faults, and modes. Provide a LCD display to indicate charge rate and battery voltage. Charger shall provide relay contacts for fault conditions as required by NFPA110.

f. Enclosure and Mounting: NEMA, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

A. Comply with NFPA 30.

B. Remote Fuel Oil Storage Tank: Provide a secondary containment base with weather shields. The tank shall be constructed of corrosion resistant steel and shall be UL 142 listed and labeled. The fuel tank shall include the following features:

1. Capacity: Provide a minimum 1500 Gallon usable fuel continuous operation at 100 percent rated power output.

2. Tank rails and lifting eyes shall be rated for the full dry weight of the tank, accessories, and weather shields.

3. Electrical stub up(s)

4. Normal & emergency vents

5. Lockable fuel fill (manual 3″ NPT)

6. Fuel fill port (minimum 2′′ NPT)

7. Mechanical fuel level gauge

8. High and low level switches to indicate fuel level

9. Leak detector switch

10. Fuel tank stainless steel heater (Phillips & Tempo Hot Fox with Auxiliary Standpipe and shut-off thermostat) or equal.

11. Provide two (2) spare 2″ NPT capped ports for future.

12. Fuel tank subbase shall include a corrosion resistant welded steel containment basin with weather shield on all sides, sized at a minimum of 110% of the tank capacity to prevent escape of fuel into the environment in the event of a tank rupture.

13. Tank design and finish shall meet the regional requirements for the Project location

2.5 DAY TANK

A. 100 gallon dual wall pump package equipped with supply and return fuel pumps, control panel, corrosion resistant painted finish tank. (Phillips model PDWTSR100-142) or equal.
B. 100 gallon capacity, 10ga. double wall tank. With 1″ NPT return w/ drop tube, 1″ NPT supply w/ drop tube, 2″ NPT mechanical level gauge, 2″ NPT basin leak detector, 3″ emergency tank vent, 3″ basin emergency tank vent, fuel pump float switches, etc.
C. Supply pump ¾ hp. 120V. w/ check valve
D. Return pump 1 hp. 120V. w/ check valve.
E. Control panel, 120V. 1 phase 60hz. Pre-wired
F. Level controller (minimum 30Amp) includes pump starters, fuses and overcurrent devices, LED control interface.
G. NEMA3R wet location rated

2.6 FUEL FILLING STATION

A. Surface wall mounted stainless steel cabinet w/ 10 gallon spill reservoir. (Morrison Bros. Co. Series 715, model #715S-TT2-2QSS) or equal.
B. Manual shut off 2″ NPT brass ball valve.
C. 2″ NPT brass ball check valve.
D. 2″ stainless steel quick connect fuel hose hub.
E. Stainless steel hand pump with interconnected tubing and valve to 2″ supply pipe.

2.7 CONTROL AND MONITORING

A. Engine generator control shall be microprocessor based and provide automatic starting, monitoring, protection and control functions for the unit.

B. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. (Switches with different

configurations but equal functions are acceptable.) When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.

C. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.

D. Configuration: Operating and safety indications, protective devices, system controls, engine gages and associated equipment shall be grouped in a common control and monitoring panel. Mounting method shall isolate the control panel from generator-set vibration. AC output power circuit breakers and other output power equipment shall not be mounted in the control enclosure.

E. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:

1. AC voltmeter (3-phase, line to line and line to neutral values).
2. AC ammeter (3-phases).
3. AC frequency meter.
4. Ammeter-voltmeter displays shall simultaneously display conditions for all three phases.
5. Emergency Stop Switch: Switch shall be a red "mushroom head" pushbutton device complete with lock-out/tag-out provisions. Depressing switch shall cause the generator set to immediately stop the generator set and prevent it from operating.
6. Fault Reset Switch: Supply a dedicated control switch to reset/clear fault conditions.
7. DC voltmeter (alternator battery charging).
8. Engine-coolant temperature gauge.
9. Engine lubricating-oil pressure gauge.
10. Running-time meter.
11. Generator-voltage and frequency digital raise/lower switches. Rheostats for these functions are not acceptable. The control shall adjustment of these parameters in a range of plus or minus 5% of the voltage and frequency operating set point (not nominal voltage and frequency values.) The voltage and frequency adjustment functions shall be disabled when the paralleling breaker is closed.

12. Fuel tank derangement alarm.

13. Fuel tank high-level shutdown of fuel supply alarm.

14. AC Protective Equipment: The control system shall include over/under voltage, reverse kVAR over current, loss of voltage reference, and over excitation shut down protection. There shall be a overload warning, and overcurrent warning alarm.

15. Status LED indicating lamps to indicate remote start signal present at the control, existing shutdown condition, existing alarm condition, not in auto, and generator set running.

16. A graphical display panel with appropriate navigation devices shall be provided to view all information noted above, as well as all engine status and alarm/shutdown conditions (including those from an integrated engine emission control system). The display shall also include integrated provisions for adjustment of the gain and stability settings for the governing and voltage regulation systems.

17. Panel lighting system to allow viewing and operation of the control when the generator room or enclosure is not lighted.

18. Data Logging: The control system shall log the latest 20 different alarm and shut down conditions, the total number of times each alarm or shutdown has occurred, and the date and time the latest of these shutdown and fault conditions occurred.

19. DC control Power Monitoring: The control system shall continuously monitor DC power supply to the control, and annunciate low or high voltage conditions. It shall also provide an alarm indicating imminent failure of the battery bank based on degraded voltage recover on loading (engine cranking).

20. Control anti condensation strip heater

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H

D. Temperature Rise: 125 / Class H environment.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, over speed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Permanent Magnet Generator (PMG) shall provide excitation power for optimum motor starting and short circuit performance.

G. Enclosure: Drip-proof.

H. Voltage Regulator: SCR type, Separate from exciter, providing performance as specified. The voltage regulation system shall be microprocessor-controlled, full wave rectified, and provide a pulse-width modulated signal to the exciter. No exceptions or deviations to these requirements will be permitted.

I. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

J. Subtransient Reactance: 15 percent maximum, based on the rating of the engine generator set.

K. Alternator strip heater

2.9 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Sound Attenuated housing. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Instruments, control, and battery system shall be mounted within enclosure.

B. Construction:

1. Hinged Doors: With padlocking provisions. Restraint/Hold back hardware to prevent door to keep door open at 180 degrees during maintenance. Rain lips over all doors.

2. Exhaust System:

a. Muffler Location: Within enclosure.

3. Hardware: All hardware and hinges shall be stainless steel.

4. Mounting Base: Suitable for mounting on sub-base fuel tank or housekeeping pad.

5. A weather protective enclosure shall be provided which allows the generator set to operate at full rated load with a static pressure drop equal to or less than 0.5 inches of water.

C. Engine Cooling Airflow through Enclosure: Housing shall provide ample airflow for engine generator operation at rated load in an ambient temperature of 40 deg C.

1. Louvers: motorized cooling-air inlet.

2. Louvers: Fixed-engine, cooling-air discharge.

D. Sound Performance: Reduce the sound level of the engine generator while operating at full rated load to a maximum of 72 dBA measured at any location 7 m from the engine generator in a free field environment.

E. Electrical package: Provide 100 Amp, three (3) phase, 4 wire house panel with MCB rated to power enclosure and generator set mounted accessories called out in this specification. Panel shall provide branch circuits prewired to the engine block heater, alternator heater, control heater, auto motorized louvers, battery charger, remote fuel tank heater, remote day tank

pumps and controls, remote lighting and convenience receptacles as required by application. Note, remote items shall be field wired and installed. All generator manufacturer's items integral to the operations within the generator enclosure shall be prewired by the generator manufacturer.

F. Site Provisions:

1. Lifting: Complete assembly of engine generator, enclosure, and sub base fuel tank (when used) shall be designed to be lifted into place as a single unit, using spreader bars.

2.10 VIBRATION ISOLATION DEVICES

A. Vibration Isolation: Generators installed on grade shall be provided with elastomeric isolator pads integral to the generator, all other locations and unless the engine manufacturer requires provide spring isolation.

2.11 FINISHES

A. Components: Powder-coated and baked over corrosion-resistant pretreatment and compatible primer. Finish shall be able to withstand atmospheric saltwater spray. Manufacturer's standard color or as directed on the drawings.

2.12 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with NFPA 110, Level 1 Energy Converters. In addition, the equipment engine, skid, cooling system, and alternator shall have been subjected to actual prototype tests to validate the capability of the design under the abnormal conditions noted in NFPA110. Calculations and testing on similar equipment which are allowed under NFPA110 are not sufficient to meet this requirement.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test engine generator set manufactured for this Project to demonstrate compatibility and functionality.

2. Full load run.

3. Maximum power.

4. Voltage regulation.

5. Steady-state governing.

6. Single-step load pickup.

7. Simulated safety shutdowns.

8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.

9. Provide fuel transfer testing for operations with use of the existing remote fuel tank.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation, application, and alignment instructions and with NFPA 110.

B. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

C. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

D. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer′s instructions and seismic requirements of the site.

E. Equipment shall be initially started and operated by representatives of the manufacturer. All protective settings shall be adjusted as instructed by the consulting engineer.

F. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

G. On completion of the installation by the electrical contractor, the generator set supplier shall conduct a site evaluation to verify that the equipment is installed per manufacturer′s recommended practice.

3.2 ON-SITE ACCEPTANCE TEST

A. The complete installation shall be tested to verify compliance with the performance requirements of this specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests. The

generator set manufacturer shall provide a site test specification covering the entire system. Tests shall include:

B. Prior to start of active testing, all field connections for wiring, power conductors, and bus bar connections shall be checked for proper tightening torque.

C. Installation acceptance tests to be conducted on site shall include a "cold start" test, a two hour full load (resistive) test, and a one-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.

D. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

3.4 SERVICE AND SUPPORT

A. The generator set supplier shall maintain service parts inventory for the entire power system at a central location which is accessible to the service location 24 hours per day, 365 days per year. The inventory shall have a commercial value of $3 million or more. The manufacturer of the generator set shall maintain a central parts inventory to support the supplier, covering all the major components of the power system, including engines, alternators, control systems, paralleling electronics, and power transfer equipment.

B. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical power system replacement parts in the local service location. Service vehicles shall be stocked with critical replacement parts. The service organization shall be on call 24 hours per day, 365 days per year. The service organization shall be physically located within 2 hours of the site.

C. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

END OF SECTION

SECTION 263600 - SERVICE ENTRANCE RATED AUTOMATIC TRANSFER SWITCHES

PART 1 GENERAL

1.01 Scope

A. Furnish and install automatic transfer switches (ATS) with number of poles, amperage, voltage, and withstand current ratings as shown on the plans. Each automatic transfer shall consist of an inherently double throw power transfer switch unit and a microprocessor controller, interconnected to provide complete automatic operation. All transfer switches and control panels shall be the product of the same manufacturer.

B. Furnish an enclosure for the (3AUS) that is for service entrance. It shall provide all of the proper disconnecting, protection, grounding and bonding required for service entrance equipment.

C. The automatic transfer switch (ATS) shall be fully compatible and able to control the associated diesel powered generator that iis designated to provide transfer. The ATS shall provide full controlling options that support the generator installed. Should the ATS not provide a controlling function required by the generator manufacturer for the proper operations of the generator the ATS manufacturer shall provide the necessary equipment and/or hardware and software necessary at no additional cost.

1.02 Acceptable Manufacturers

Service entrance automatic transfer switches shall be ASCO Series 3AUS. Any alternate shall meet the specifications and physical sizing for a turnkey installation. Each alternate submitted manufacturer must list any deviations from this specification for review and approval. No approval will be granted during bidding phase of project.

A. Acceptable manufacturers:
   1. ASCO (Basis of Design)
   2. Cummins Power

1.03 Codes and Standards

The service entrance automatic transfer switch and accessories shall conform to the requirements of:

A. UL 1008 Listed for Optional Standby Transfer Switches (Manual Transfer Switches)

B. CSA C22.2 No.178 1978

C. IEC 60947-6-1 Low – Voltage Switchgear and Controller

D. NFPA 70 - National Electrical Code

E. NFPA 99 – Essential Electrical Systems for Health Care Facilities

F. IEEE Standard 446 - IEEE Recommended Practice for Emergency and StandbyPower Systems for Commercial and Industrial Applications

G. UL 508 Industrial Control Equipment

H. UL 891 Switchboards

I. NEC Articles 700, 701, 702

J. International Standards Organization ISO 90estrication 01: 2008

K. RoHs compliant (Restriction of Hazardous Substances)

L Seismic qualification – International Building Code & OSHPD to SDS level of 2.5

PART 2 PRODUCTS

2.01 Mechanically Held Transfer Switch

A. The transfer switch unit shall be electrically operated and mechanically held. The electrical operator shall be a single-solenoid mechanism, momentarily energized. Main operators which include overcurrent disconnect devices will not be accepted. The switch shall be mechanically interlocked to ensure only one of two possible positions, normal or emergency.

B. The switch shall be positively locked and unaffected by momentary outages so that contact pressure is maintained at a constant value and temperature rise at the contacts is minimized for maximum reliability and operating life.

C. Pipe Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

D. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. A manual operating handle shall be provided for maintenance purposes. The handle shall permit the operator to manually stop the contacts at any point throughout their entire travel to inspect and service the contacts when required.

E. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.

F. Where neutral conductors must be switched, the ATS shall be provided with fully-rated neutral transfer contacts.

G. Where neutral conductors are to be solidly connected, a neutral terminal plate with fully-rated AL-CU pressure connectors shall be provided.

2.02 Group G Controller with Integrated User Interface Panel

A. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance.

B. The controller shall direct the operation of the transfer switch. The controller’s sensing and logic shall be controlled by a built – in microprocessor for maximum reliability, minimum maintenance, inherent serial communications capability, and the ability to communicate via Ethernet through optional communications module.

C. A single controller shall provide single and three phase capability for maximum application flexibility and mimimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to ± 1% of nominal voltage. Frequency sensing shall be accurate to ± 0.1 Hz. Time delay settings shall be accurate to ± 0.5% of the full scale value of the time delay. The panel shall be capable of operating over a temperature range of -20 to + 70 degrees C, and storage from -55 to + 85 degrees C.

D. The controller shall be enclosed with a protective cover and be mounted separate from the transfer switch unit for safety and ease of maintenance. Senisng and control logic shall be provided on printed circuit boards.

E. The controller shall meet or exceed the requirements for Electromagnetic Compability (EMC) as follows:

1. IEC 60947-6-1 Multiple Function Equipment Transfer Switching Equipment.
   61000-4 Testing And Measurement Techniques – Overview

   a. IEC 61000 – 4 – 2 Electrostatic Discharge Immunity

   b. IEC 61000 - 4 – 3 Radiated RF Field Immunity

   c. IEC 61000 – 4 – 4 Electrical Fast Transient/Burst Immunity

   d. IEC 61000 – 4 – 5 Surge Immunity

   e. IEC 61000 – 4 – 6 Conducted RF Immunity

2. CISPR 11 – Conducted RF Emissions and Radiated RF Emiissions

2.03 Enclosure

A. The service entrance 3AUS shall be furnished in a NEMA type 1 enclosure unless otherwise shown on the plans.

B. Provide strip heater with thermostat for Type 3R enclosure requirements.

C. Controller shall be mounted on, visable, and operational through enclosure door..

D. The complete assembly shall be degreased, and thoroughly cleaned through a five-stage aqueous process. The finish shall be ANSI-61, light gray, electrostatically-charged polyester powder paint over a phosphate coating, at a minimum of 2.0 mils in density. Finish shall be suitable for indoor and outdoor environments.

E. For those automatic transfer switches that are less than 1000 amperes (unless otherwise indicated on the drawings), the connection between the normal disconnecting device and the ATS shall be made with the appropriate size cable. For those automatic transfer switches that are greater than 1000 amperes, the connection between the normal disconnecting device and the ATS shall be made with the appropriate size bus (unless otherwise indicated on the drawings).

F. A pressure disconnect link shall be provided to disconnect the normal source neutral connection from the emergency and load neutral connections for 4-wire applications. A ground bus shall be provided for connection of the grounding conductor to the grounding electrode. A pressure disconnect link for the neutral to ground bonding jumper shall be provided to connect the normal neutral connection to the ground bus.

G. Control wiring shall be rated for 600 volt, UL 1015. Wires shall be placed in wire duct or harnessed, and shall be supported to prevent sagging or breakage from weight or vibration. All wiring to hinged doors shall be run through door terminal blocks or connection plugs.

PART 3 OPERATIONS

3.01 Controller Display and Keypad

A. A 128*64 graphical LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters.
Operational parameters shall also be available for viewing and limited control through communications port. The following parameters shall only be adjustable via DIP switches on the controller.

1. Nominal line voltage and frequency

2. Single or three phase sensing on normal

3. Transfer operating mode configuration, (open transition, or delayed transition)

All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

3.02 Voltage and Frequency Sensing

A. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup,dropout, and trip settings capabilities (values shown as % of nominal unless otherwise specified.

Parameter	Sources	Dropout/Trip	Pickup/Reset
Undervoltage	N & E	70 to 98%	85 to 100%
Overvoltage	N & E	102 to116%	2% below trip
Underfrequency	N & E	85 to 98%	86 to 100%
Overfrequency	N & E	101 to 111%	2% bellow trip

B. Repetitive accuracy of all settings shall be within 1% at +25C

C. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.

D. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage and frequency. *Note: Single phase sensing on emergency*

E. The backlit 128*64 graphical display shall have multiple language capability.
Languages can be selected from the user interface.

3.03 Time Delays

A. A time delay shall be provided to override momentary normal source outages and delay all transfer and engine starting signals, adjustable 0 to 6 seconds. It shall be possible to bypass the time delay from the controller user interface.

B. A time delay shall be provided on transfer to emergency, adjustable from 0 to 59 seconds for controlled timing of transfer of loads to emergency. It shall be possible to bypass the time delay from the controller user interface.

C. A generator stabilization time delay shall be provided after transfer to emergency adjustable 0 or 4 seconds.

D. A time delay shall be provided on retransfer to normal, adjustable 0 to 19 minutes 59 seconds. Time delay shall be automatically bypassed if emergency source fails and normal source is acceptable. The transfer to normal power shall be maintained during generator cooldown mode.

E. A cooldown time delay shall be provided on shutdown of engine generator, Field adjustable 0 to 60 minutes 59 seconds.

F. All adjustable time delays shall be field adjustable without the use of special tools.

G. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0 to 5 minutes 59 seconds time delay in any of the following modes:

1. Prior to transfer only.

2. Prior to and after transfer.

3. Normal to emergency only.

4. Emergency to normal only.

5. Normal to emergency and emergency to normal.

6. All transfer conditions or only when both sources are available.

H. In the event that the alternate source is not accepted within the configured Failure to Accept time delay, the common alert indication shall become active.

I. The controller shall also include the following built-in time delay for delayed transition operation.

1. A time delay for the load disconnect position for delayed transition operation adjustable 0 to 5 minutes 59 seconds.

3.04 Additional Features

A. The user interface shall be provided with test/reset modes. The test mode will simulate a normal source failure. The reset mode shall bypass the time delays on either transfer to emergency or retransfer to normal.

B. A set of contacts rated 5 amps, 30 VDC shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down. setting, regardless of whether the normal source restores before the load is transferred.

C. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed when the ATS is connected to the emergency source.

D. A single alarm indication shall light up the alert indicator and de – energize the configured common alarm output relay for external monitoring.

E. LED indicating lights shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).

F. LED indicating lights shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal (green) and emergency (red) source, as determined by the voltage sensing trip and reset settings for each source.

G. LED indicating light shall be provided to indicate switch not in automatic mode (manual); and blinking (amber) to indicate transfer inhibit.

H. LED indicating light shall be provided to indicate any alarm condition or active time delay (red).

The following features shall be built – into the controller, but capable of being activated through keypad programming or the serial port only when required by the user:

I. Provide the ability to select "commit/no commit to transfer" to determine whether the Load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.

J. A variable window inphase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The inphase monitor shall be specifically designed for and be the product of the ATS manufacturer. The inphase monitor shall be equal to ASCO feature 27.

K. An engine generator exercising timer shall be provided to configure weekly and bi-weekly automatic testing of an engine generator set with or without load for 20 minutes fixed. It shall be capable of being configured to indicate a day of the week, and time weekly testing should occur.

The following feature shall be built – into the controller, but capable of being activated through keypad programming,communications interface port, or additional hardware.

L. Terminals shall be provided for a remote contact to signal the ATS to transfer to emergency. This inhibit signal can be enabled through the keypad or serial port.

M System Status - The controller LCD display shall include a "System Status" screen which shall be readily accessible from any point in the menu by depressing the "ESC" key. This screen shall display a clear description of the active operating sequences and switch position. For example,

Normal Failed
Load on Normal
TD Normal to Emerg

2min15s

Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the operator's manual are not permissible.

N. Self Diagnostics – The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.

O. Communications Interface – The controller shall be capable of interfacing, through an optional serial communication port with a network of transfer switches, locally (up to 4000 ft.). Standard software specific for transfer switch applications shall be available by the transfer switch manufacturer. This software shall allow for the monitoring, control, and setup of parameters.

P. Data Logging – The controller shall have the ability to log data and to maintain the last 300 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non – volatile memory.

1. Event Logging

    a. Data and time and reason for transfer normal to emergency
    b. Data and time and reason for transfer emergency to normal
    c. Data and time and reason for engine start
    d. Data and time engine stopped
    e. Data and time emergency source available
    f. Data and time emergency source not available

2. Statistical Data

    a. Total number of transfers
    b. Total number of transfers due to source failure
    c. Total number of day's controller is energized
    d. Total number of hours both normal and emergency sources are
    e. Available
    f. Total time load is connected to normal
    g. Total time load is connected to emergency
    h. Last engine start
    i. Last engine start up time
    j. Input and output status

4.01 Optional Features *(The following section is optional and should be deleted if not required)*

A. Accessory Package - An accessory bundle shall be provided that includes:

1. A fully programmable engine exerciser with seven independent routines to exercise the engine generator, with or without load on a daily weekly, bi – weekly, or monthly basis.

2. Event log display that shows event number, time and date of events, event type, and reason (if applicable). A minimum of 300 events shall be stored.

3. RS – 485 communications port enabled.

4. Common alarm output contact.

(This feature shall be equal to ASCO accessory 11BE, and shall be capable of being activated for existing switches through optional accessory dongle).

B. Controller Power Supply - A backup power UPS shall be provided to allow controller to run for 3 minutes minimum without AC power. (This feature shall be equal to ASCO accessory 1UP, and shall be capable of being added to existing switches without modification).

C. Expansion Module - A relay expansion module (REX) is a standard feature when delayed transition transfer is specified. A REX module shall also be provided for open transition transfer that includes one form C contact for source availability of the normal (18G) and emergency (18B) sources. Additional output relay shall be provided to indicate a common alarm. The REX module shall have the capability of being daisy chained for multiple sets of contacts. (This feature shall be equal to ASCO accessory 18RX, and shall be capable of being added to existing switches without modification).

D. Current Sensing Card - A load current metering card shall be provided that measures either single or three phase load current. It shall include current transformers (CT's) and shorting block. Parameters shall be able to be viewed via the user interface. (This feature shall be equal to ASCO accessory 23GA (single phase), 23GB (three phase), and shall be capable of being added to existing switches without modification).

E. Communications Module – Shall provide remote interface module to support monitoring of vendor's transfer switch, controller and optional power meter. Module shall provide status, analog parameters, event logs, equipment settings & configurations over embedded webpage and open protocol. Features shall include:

1. Email notifications and SNMP traps of selectable events and alarms may be sent to a mobile device or PC.
2. Modbus TCP/IP, SNMP, HTTP, SMTP open protocols shall be simultaneously supported.
3. Web app interface requiring user credentials to monitor and control the transfer switch supporting modern smart phones, tablets and PC browsers. User will be able to view the dynamic one-line, ATS controls status, alarms, metering, event logging as well as settings.
4. Secure access shall be provided by requiring credentials for a minimum of 3 user privilege levels to the web app, monitor (view only), control (view and control) and administrator (view, control and change settings). 128-Bit AES encryption standard shall be supported for all means of connectivity.
5. Shall allow for the initiating of transfers, retransfers, bypassing of active timers and the activating/deactiviting of engine start signal shall be available over the embedded webpage and to the transfer switch vendor's monitoring equipment.
6. An event log displaying a minimum of three-hundred (300) events shall be viewable and printable from the embedded webpages and accessible from supported open protocols.
7. Four (4) 100 Mbps Ethernet copper RJ-45 ports, two (2) serial ports, and LEDs for diagnostics.
8. DIN rail mountable.

This option shall be equivalent to ASCO accessory 72EE

F. Surge Suppression – A TVSS with a surge current rating of 65kA shall be provided with individually matched fused metal oxide varistors (MOVs). It shall include LED status indication of normal operation, under voltage, power loss, phase loss or component failure. Shall include form C dry contacts for external alarm or monitoring. The unit shall be enclosed in a Noryl housing rated NEMA 4, 12, and 4X. Shall comply with UL 1449 3rd edition (This feature shall be equal to ASCO accessory 73, and shall be capable of being added to existing switches).

G Power Meter – (This feature shall be equal to ASCO accessory 135L, or feature bundle accessory 150*).

The Power Meter shall conform to the requirements of:

1. UL 3111-1-Electrical Measuring and Testing Equipment
2. CAN/CSA-C22.2 No. 23-M89-CSA Safety Requirements for Electrical and Electronic Measuring and Test Equipment

3. The Power Meter shall be capable of operating without modification at a nominal frequency of 45 to 66Hz.

4. The Power Meter shall be rated for an operating temperature of -4°F to 158°F and a storage temperature of -22°F to 176°F. and shall be rated for an 85% non-condensing, relative humidity.

5. The Power Meter shall accept inputs from industry standard instrument transformers (120 VAC secondary PT's and 5A secondary CT's). Direct phase voltage connections, 0 to 600VAC nominal, shall be possible without the use of PT's.

6. The Power Meter shall accept single, 3 phase, or three & four wire circuits. A fourth CT input shall be available to measure neutral or ground current.
7. The Power Meter shall contain a built-in discrete contact to wire an ATS 14A auxiliary contact to indicate switch position.

8. The Power Meter shall accept AC voltage from the sensing lines for operation. Additional provisions shall be provided for external DC voltage input range 9-36 VDC with a nominal of 24 VDC.

9. The Power Meter shall be equipped with a continuous duty, long –life, 4 line x 20 character green backlit LCD

10. All setup parameters required by the Power Meter shall be stored in non-volatile memory and retained in the event of a control power interruption.

11. The Power Meter shall be flush mountable on a surface.

12. The Power Meter enclosure shall be sealed to IP-51 (NEMA 1) and the faceplate shall be sealed to IP-65 (NEMA 4). All push buttons shall be sealed tact switches.

13. The Power Meter shall send, when prompted, information to a central location equipped with a manufacturer supplied critical power management system or 3rd party monitor through manufacturer supplied communication modules. All 3rd party monitor must utilize industry standard open protocols Modbus/RTU.Modbus/TCP or SNMP.

14. An embedded RS-485 port will be provided which will enable communication at 9600, 19.2K, 38.4K, or 57.6K baud. DIP switches will be provided on the RS-485 port allowing a user to select 2-wire or 4-wire communication as well as the option to activate a terminating resistor on the port.

15. The Power Meter shall help facilities comply with NEC 220. It shall provide Maximum Demand calculations for the past 24 months, as per standards with 15 minute averages.

16. The following data will be available on the display and Modbus registers of the Power Meter:
    - *Line-to-neutral voltages (V_{AN}, V_{BN}, and V_{CN})*
    - *Line-to-neutral voltage average (V_{AVE})*
    - *Line-to-line voltages (V_{AB}, V_{BC}, and V_{CA})*
    - *Line-Line voltage average (V_{LAVE})*
    - *Current on each phase (I_A,I_B,and I_C)*
    - *Current on the neutral conductor (I_N)*
    - *Average current (I_{AVE})*
    - *Active power, KW per phase and total (W_A,W_B,W_C, and WT)*
    - *Apparent power, KVA per phase and total (V_{AA}, V_{AB}, V_{AC}, and V_{AT})*
    - *KWHours importing, exporting and net (KWH_{IMP}, KWH_{EXP}, and KWH_{NET})*
    - *KVARHours leading, lagging and net ($KVARH_{LEAD}$, KVARLAG, and KVARHNET)*
    - *Power factor (PF)*
    - *Signal Frequency (Hz)*
    - *Digital Input*

17. The Power Meter shall offer an LCD which can display no less then nine different languages.

18. Displaying each of the metered values shall be done through the use of menu scroll buttons. There will be an escape button which will be used to take the user back to the previous page or to cancel a setting change. Pressing escape no more than three times will return the user to the

home screen.

19. For ease of operator viewing, the display can be configured to remain on continuously, with no detrimental effect on the life of the Power Meter.

20. The display's contrast shall be configurable in intervals of 10% (ranging 0%-100%).

21. Setup of a system requirements shall be allowed from the front of the Power Meter.

5.01 ATS Remote Annunciator

General

Provide and install ATS Remote Annunciators for monitoring and control of automatic transfer switches remotely over Ethernet.

A. Hardware Specifications

The ATS Remote Annunciator shall be listed to cUL-60950-1 and UL 1008 and include the following features and ratings*:*

- *User-configured labels with ATS names and power sources*
- *Dual 10/100 Base-T auto sensing and auto crossover Ethernet ports*
- *LED indication of source acceptability, switch position, common alarm, time delay and Ethernet link activity*
- *Push button for transfer/retransfer control operations and time delay bypass*
- *Push buttons for Alarm Silence and Lamp Test*
- *Key lock to enable and disable the transfer push button*
- *Audible and visual alarm to indicate Communication Error ATS Locked Out Failure to Synchronize Extended Parallel and any of the 8 user-configured discrete inputs*
- *Programmable watchdog timer that can generate a system reset upon timeout (minimum 1 sec)*
- *Factory reset capability*
- *100 ms power ride-through*

B. Software Specification

The ATS Remote Annunciator shall contain embedded web pages accessible via various web browsers with the following capabilities:

- *Configuration for protocol and communications management with the ability of auto discovering transfer switches on network*
- *Ability to create and print customized labels for ATS names and power sources*
- *The ability to choose a continuous or periodic audible alarm with customizable interval time*
- *View detailed packet status counters i.e. transmitted received and dropped packets with the ability to reset counters*
- *ATS source name configuration page which allows users to configure power source names and print labels*
- *Upgrade firmware from Ethernet network without interrupting equipment operation*

C. Communications

Dual 10/100 Base-T (RJ-45) Ethernet ports are provided to support TCP/IP communications for up to eight automatic transfer switches via individual remote connectivity modules or daisy-chained serial modules into a single Connectivity Module. Additional features include:

- *Supports Full Duplex Flow Control (IEEE 802.3x)*
- *3.3V power supply with 5V I/O tolerance*
- *Supports 3 LEDs to indicate traffic link speed and collision*

D. Mounting

The ATS Remote Annunciator is suitable for:

- *Surface mounting using mounting screws studs*
- *Flush Mount from behind a cutout section (Enclosure Door Mounting)*
- *Flush Mount from the front of a cutout section (Enclosure Door Mounting)*

E. Power Supply

The ATS Remote Annunciator shall be capable of accepting 24VDC, 120 VAC or 240 VAC power source.

F. Environmental

The ATS Remote Annunciator shall have an Ambient Operating Temperature range of -4 º to 158 º F (-20 º to +70 º C) @ 5~85% humidity and Ambient Storage Temperature of -40 º to 185 º F (-40 º to 85 º C).

5.02 Disconnecting and Overcurrent Protection Device

A. For those automatic transfer switches less than 1000 amperes, the normal connection shall be provided with a thermal magnetic rated molded case circuit breaker with current ratings as shown on the plans. It shall have a thermal magnetic trip unit.

B. For those automatic transfer switches rated above 1000 amperes, the normal connection shall be provided with a stationary mount, insulated case circuit breaker with a solid-state trip unit. The trip unit shall have an adjustable long time, short time, instantaneous, and ground fault trip settings. The insulated case circuit breaker shall trip open when the ground fault setting is exceeded.

ADDITIONAL REQUIREMENTS

6.01 Ampere Interrupting Capacity (AIC)

A. The maximum short circuit current the breaker shall be required to interrupt is as follows:

Switch Rating	AIC Rating	Voltage
70 - 225	25,000A	480V
250, 400	50,000A	480V
600	50,000A	480V
800 – 2000	65,000A	480V
2500, 3000	100,000A	480V

6.02 Tests and Certification

A. The complete 3AUS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.

B. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.

C. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001:2008.

6.03 Service Representation

A. The ATS manufacturer shall maintain a national service organization of company-employed personnel located throughout the contiguous United States. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.

B. The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

C. For ease of maintenance and parts replacement, the switch nameplate shall include drawing numbers, part numbers for main coil and control.

END OF SECTION

SECTION 264313 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.

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

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Comply with UL 1449.

D. MCOV of the SPD shall be the nominal system voltage.

2.2 SERVICE ENTRANCE AND TRANSFER SWITCH SUPPRESSOR

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

1. ABB Electrification Products.
2. Eaton.
3. Leviton Manufacturing Co., Inc.
4. Liebert; a brand of Vertiv.
5. Schneider Electric USA, Inc.
6. Siemens Industry, Inc., Energy Management Division.

B. SPDs: Comply with UL 1449, Type 2.

1. SPDs with the following features and accessories:

a. Integral disconnect switch.

b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.

c. Indicator light display for protection status.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 480 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 480Y/277 V.
2. Line to Ground: 1200 V for 480Y/277 V.
3. Line to Line: 2000 V for 480Y/277 V.

E. SCCR: Equal or exceed 200 kA.

F. Inominal Rating: 20 kA.

2.3 PANEL SUPPRESSORS

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

1. ABB Electrification Products.
2. Eaton.
3. Leviton Manufacturing Co., Inc.
4. Schneider Electric USA, Inc.

5. Siemens Industry, Inc., Energy Management Division.

B. SPDs: Comply with UL 1449, Type 2.

1. Include LED indicator lights for power and protection status.

2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 480Y/277 V.
2. Line to Ground: 1200 V for 480Y/277 V.
3. Neutral to Ground: 1200 V for 480Y/277 V.
4. Line to Line: 2000 V for 480Y/277 V

E. SCCR: Equal or exceed 100 kA.

F. Inominal Rating: 20 kA.

2.4 ENCLOSURES

A. Outdoor Enclosures: NEMA 250, Type 3R.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

E. Complete startup checks according to manufacturer's written instructions. Energize SPDs after power system has been energized, stabilized, and tested.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Compare equipment nameplate data for compliance with Drawings and Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 264313

265100 – LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following types of LED luminaires:

1. Cylinder.
2. Downlight.
3. Lowbay.
4. Recessed linear.
5. Strip light.
6. Surface mount, linear.
7. Surface mount, nonlinear.
8. Suspended, linear.
9. Suspended, nonlinear.
10. Materials.
11. Finishes.
12. Luminaire support.

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. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, arranged by designation.

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. Sustainable Design Submittals:

1. Provide point by point photometric design comparison for all areas.

D. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale and coordinated with each other, using input from installers of the items involved:

B. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.

C. Product Certificates: For each type of luminaire.

D. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five (5) years (including parts, labor and materials) from date of Substantial Completion.

PART 2 - PRODUCTS

1. See Electrical Drawings for detailed lighting fixture schedule.

2.2 PERFORMANCE REQUIREMENTS

A. 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[and the luminaire will be fully operational during and after the seismic event]."

2.3 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. Standards:

1. ENERGY STAR certified.

2. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

3. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
4. UL Listing: Listed for damp location.
5. Recessed luminaires shall comply with NEMA LE 4.

C. CRI of minimum 70. CCT of 4000 K for exterior pole lights. 3500K for all interior lights, unless noted otherwise on the lighting fixture schedule.

D. Rated lamp life of 50,000 hours to L70.

E. Light fixtures shall have the ability to be dimmable minimum 0-10V.

F. Lamps dimmable from 100 percent to 0 percent of maximum light output.

G. Internal driver.

H. Nominal Operating Voltage: 120 V ac, 277 V ac (Universal) See drawings for specific application voltage.

1. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

I. Housings:

1. Die-cast aluminum unless specified otherwise.

2.4 CYLINDER

A. See Electrical Drawings for detailed lighting fixture schedule.

B. Include mounting bracket and/or assembly as required per the manufacturer's recommendations.

2.5 DOWNLIGHT

A. See Electrical Drawings for detailed lighting fixture schedule.

B. Universal mounting bracket.

C. Integral junction box with conduit fittings.

D. Optics: As

2.6 LOWBAY

A. See Electrical Drawings for detailed lighting fixture schedule.

B. Universal mounting bracket.

2.7 RECESSED LINEAR

A. See Electrical Drawings for detailed lighting fixture schedule.

B. Integral junction box with conduit fittings.

2.8 STRIP LIGHT

A. See Electrical Drawings for detailed lighting fixture schedule.

B. Integral junction box with conduit fittings.

2.9 SURFACE MOUNT, LINEAR

A. See Electrical Drawings for detailed lighting fixture schedule.

B. Integral junction box with conduit fittings.

2.10 SURFACE MOUNT, NONLINEAR

A. See Electrical Drawings for detailed lighting fixture schedule.

B. Integral junction box with conduit fittings.

2.11 SUSPENDED, LINEAR

A. See Electrical Drawings for detailed lighting fixture schedule.

2.12 SUSPENDED, NONLINEAR

A. See Electrical Drawings for detailed lighting fixture schedule.

B. Integral junction box with conduit fittings.

2.13 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, and Globes:

D. See Electrical Drawings for detailed lighting fixture information.

1. Acrylic: One hundred 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. Housings:

1. Die-cast-aluminum housing and heat sink, unless otherwise noted.

2.14 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.

2.15 LUMINAIRE SUPPORT

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.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Rod Hangers: 3/8-inch minimum diameter, cadmium-plated, threaded steel rod.

D. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports: Sized and rated for luminaire weight.

E. Flush-Mounted Luminaire Support: Secured to outlet box.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls or attached to a minimum 20 gauge backing plate or attached to wall structural members or attached using through bolts and backing plates on either side of wall unless specified otherwise.
2. Do not attach luminaires directly to gypsum board.

G. Ceiling-Mounted Luminaire Support:
1. Ceiling mount with pendant mounted all-thread.

H. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

J. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. 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.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 265100

265600 – LED EXTERIOR LIGHTING

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.
4. Luminaire Pole.

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. Delegated-Design Submittal: For luminaire supports.

1. Include design calculations for luminaire supports with wind load restriction up to 125 MPH for a minimum of 60 seconds.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale and coordinated. Signed and Sealed by a certified Professional Engineer registered in the State of New Jersey.

B. Product Certificates: For each type of the following:

1. Luminaire.
2. Photoelectric relay.
3. Pole system.
4. Wind load certification.

C. 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.
3. Provide As-Built Drawings including photometrics and shield requirements.

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 agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
1. Warranty Period: five year(s) (including parts, labor and materials) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 Approved Manufacturers:

A. Kim Lighting (Basis of Design)

B. Beacon Lighting

C. Hess America Lighting

D. Or Equal

2.2 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."

2.3 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. UL Compliance: Comply with UL 1598 and listed for wet location.

D. Lamp base complying with ANSI C81.61 and IEC 60061-1.

E. CRI of minimum 70. CCT of 4000 K, unless noted otherwise.

F. L70 lamp life of 50,000 hours.

G. Lamps dimmable from 100 percent to 0 percent of maximum light output.

H. Nominal Operating Voltage: 120 V ac/208Vac/240 V ac/277 V ac. Unless noted otherwise on drawings

I. Lamp Rating: Lamp marked for outdoor use.

J. Source Limitations: Obtain luminaires from single source from a single manufacturer.

2.4 LUMINAIRE TYPES

A. Area and Site:
1. Luminaire Shape: see lighting fixture schedule for fixture styles.
2. Mounting: Pole (supplied with luminaire)

3. Pole – Round (supplied with luminaire)
4. Luminaire-Mounting Height: See Drawings.
5. Distribution: See lighting fixture schedule for type and specific locations: Type 2, Type 3, Type 4, Type 5QM

2.5 LUMINAIRE POLE

A. Pole construction shall be seamless 4 inch diameter round straight (non-tapered) extruded aluminum tube (alloy 6061-T6). Welded to the top and bottom casting of alloy 356.

B. Base cover; two-piece cast aluminum full cover 316 alloy secured by stainless steel screws.

C. Pole cap; flush sided cast aluminum to accept side arm mounted luminaires.

D. Handhole; provide gasketed cover with grounding lug at 18” up from anchor base.

E. All poles above 25’-0” provide factory installed vibration dampener.

F. Anchor Bolts; Four (4) hot dipped galvanized with eight nuts, flat washers and installation template.

G. Finish; Thermoset polyester powder coat paint finish with a minimum of 3.0 mil thickness.

H. Strength; The pole shall meet the minimum rated EPA as derived from AASHTO standard. Or minimum 130MPH whichever is stronger. Contractor shall provide signed and sealed certification by a State oof New Jersey Professional Engineer for any changes to wind load applications.

2.6 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum for use in salt water spray situations. 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 re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping 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. 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.

2.7 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. 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. 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: per owner selection. Provide color samples for owner approval.

b. Finish shall provide protection from saltwater (seawater) spray.

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 re-lamping.
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.
5. Luminaire shall be able to withstand minimum of 125 MPH wind load for a minimum of 60 seconds.

F. Wiring Method: Install cables in raceways. Conceal raceways and cables.

G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.

H. Coordinate layout and installation of luminaires with other construction.

I. 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.

J. Comply with requirements in Section 260519 "Conductors and Cables" and Section 260533 "Raceways and Boxes" for wiring connections and wiring methods.

3.2 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

A. Aim as indicated on Drawings.

B. Install on colored concrete base with top 30 inches 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 16130 "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 16075 "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-52.

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. Luminaire Pole; provide a certified wind testing report by the pole manufacturer states the pole can withstand a minimum wind load requirement as mandated by the latest edition of the International Building Code for the location the poles are being installed, but not less than 125 MPH (56 m/s).

F. 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 265600

SECTION 271323 - COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. The Communications Optical Fiber cabling shall be in accordance with the Municipalities standards and guidelines. The system shall be interconnected to the backbone cabling of the existing fiber optic infrastructure used throughout the city. The contractor shall provide coordination with the City to ensure the interconnection and fiber optic systems provided are in compliance with the City and fully compatible with their existing fiber optic infrastructure.

B. Section Includes:

1. Type OFNR optical fiber cable.
2. Type OFCR optical fiber cable.
3. Type OFNP optical fiber cable.
4. Type OFCP optical fiber cable.
5. Types OFN and OFNG optical fiber cable.
6. Types OFC and OFCG optical fiber cable.
7. Optical fiber cable hardware.

1.2 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

B. Shop Drawings:

1. System Labeling Schedules:

a. Electronic copy of labeling schedules, in software and format selected by Owner.

2. Cabling administration drawings and printouts.
3. Wiring diagrams showing typical schematic arrangement, including the following:

a. Telecommunications rooms plans and elevations.
b. Telecommunications pathways.
c. Telecommunications system access points.
d. Telecommunications grounding system.
e. Cross-connects.

f. Patch panels.
g. Patch cords.

4. Cross-Connect and Patch-Panel Drawings: Detail mounting assemblies and show elevations and physical relationship between installed components.

C. Certificates:

1. For each type of product.

D. Field Quality-Control Submittals:

1. Optical fiber cable testing plan.
2. Field quality-control reports.

E. Sustainable Design Submittals:
1. Product data
2. UL certifications
3. Testing reports
4. Compliance report detailing compatibility.

1.4 INFORMATIONAL SUBMITTALS

A. Source Quality-Control Submittals:

1. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For optical fiber cable, splices, and connectors.

PART 2 - PRODUCTS

2.1 TYPE OFNR OPTICAL FIBER CABLE

A. Description: This category covers jacketed optical fiber cable for use as risers in vertical runs in shaft or between floors within buildings in accordance with Article 770 of NFPA 70 containing no electrically conductive materials.

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN QAYK; including UL 1651.
3. General Characteristics:

a. Performance: TIA-568.3.

b. Inside Plant Mechanical Properties: ICEA S-83-596.
c. Inside-Outside Plant Mechanical Properties: ICEA S-104-696.
d. Jacket:

1) Cable cordage jacket, fiber, unit, and group color in accordance with TIA-598.
2) Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inch (1 m).

C. Type OFNR, Optical Fiber Nonconductive Riser; Designation OM1, Multimode Optical Fiber Cable

1. Acceptable Manufacturers:
a. Belden
b. Corning Inc.
c. L-Com
d. Optical Cable Corp.
e. Or equal

2. Additional Characteristics:

a. Construction: TIA-492AAAA; 62.5 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 200 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

3. Options:

a. Configuration: 6-fiber, tight buffer, optical fiber cable.
b. Maximum Attenuation: 3.50 dB/km at 850 nm wavelength; 1.5 dB/km at 1300 nm wavelength.
c. Jacket Color: Orange.

D. Type OFNR, Optical Fiber Nonconductive Riser; Designation OM2, Multimode Optical Fiber Cable

1. Acceptable Manufacturers:
a. Belden
b. Corning Inc.
c. L-Com
d. Optical Cable Corp.
e. Or equal

2. Additional Characteristics:

a. Construction: TIA-492AAAB; 50 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

3. Options:

a. Configuration: 6-fiber, tight buffer, optical fiber cable.

b. Maximum Attenuation: 3.50 dB/km at 850 nm wavelength; 1.5 dB/km at 1300 nm wavelength.
c. Jacket Color: Orange.

E. Type OFNR, Optical Fiber Nonconductive Riser; Designation OM3, Multimode Optical Fiber Cable

1. Acceptable Manufacturers:
   a. Belden
   b. Corning Inc.
   c. L-Com
   d. Optical Cable Corp.
   e. Or equal

2. Additional Characteristics:

   a. Construction: TIA-492AAAC; 850 nm laser-optimized, 50 µm core diameter, 125 µm cladding diameter.
   b. Minimum Overfilled Modal Bandwidth-Length Product: 1500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.
   c. Minimum Effective Modal Bandwidth-Length Product: 2000 MHz-km at 850 nm wavelength.

3. Options:

   a. Configuration: 6-fiber, tight buffer, optical fiber cable.
   b. Maximum Attenuation: 3.50 dB/km at 850 nm wavelength; 1.5 dB/km at 1300 nm wavelength.
   c. Jacket Color: Aqua.

F. Type OFNR, Optical Fiber Nonconductive Riser; Designation OM4, Multimode Optical Fiber Cable :

1. Acceptable Manufacturers:
   a. Belden
   b. Corning Inc.
   c. L-Com
   d. Optical Cable Corp.
   e. Or equal

2. Additional Characteristics:

   a. Construction: TIA-492AAAD; 850 nm laser-optimized, 50 µm core diameter, 125 µm cladding diameter.
   b. Minimum Overfilled Modal Bandwidth-Length Product: 3500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.
   c. Minimum Effective Modal Bandwidth-Length Product: 4700 MHz-km at 850 nm wavelength.

3. Options:

a. Configuration: 6-fiber, tight buffer, optical fiber cable.
b. Maximum Attenuation: 3.50 dB/km at 850 nm wavelength; 1.5 dB/km at 1300 nm wavelength.
c. Jacket Color: Aqua

G. Type OFNR, Optical Fiber Nonconductive Riser; Designation OS1, Inside-Outside Plant, Single-Mode Optical Fiber Cable

1. Acceptable Manufacturers:
   a. Belden
   b. Corning Inc.
   c. L-Com
   d. Optical Cable Corp.
   e. Or equal
2. Additional Characteristics:

   a. Construction: TIA-492CAAA; 9 µm core diameter, 125 µm cladding diameter.
   b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

3. Options:

   a. Configuration:

      1) 6 - 12-fiber, single loose tube, optical fiber cable.
      2) 24 - 144-fiber, stranded loose tube, optical fiber cable.

   b. Maximum Attenuation: 0.5 dB/km at 1310 nm wavelength; 0.5 dB/km at 1550 nm wavelength.
   c. Jacket Color: Yellow.

H. Type OFNR, Optical Fiber Nonconductive Riser; Designation OS2, Inside-Outside Plant, Single-Mode Optical Fiber Cable

1. Acceptable Manufacturers:
   a. Belden
   b. Corning Inc.
   c. L-Com
   d. Optical Cable Corp.
   e. Or equal
2. Additional Characteristics:

   a. Construction: TIA-492CAAB; 9 µm core diameter, 125 µm cladding diameter, with low water peak.
   b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

3. Options:

   a. Configuration:

1) 6 – 12 -fiber, single loose tube, optical fiber cable.
2) 24 - 144-fiber, stranded loose tube, optical fiber cable.

b. Maximum Attenuation: 0.5 dB/km at 1310 nm wavelength; 0.5 dB/km at 1550 nm wavelength.
c. Jacket Color: Yellow.

2.2 TYPE OFCR OPTICAL FIBER CABLE

A. Description: This category covers jacketed optical fiber cable for use as risers in vertical runs in shaft or between floors within buildings in accordance with Article 770 of NFPA 70 containing noncurrent-carrying electrically conductive materials.

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
2. Listing Criteria: UL CCN QAYK; including UL 1651.
3. General Characteristics:

a. Performance: TIA-568.3.
b. Inside Plant Mechanical Properties: ICEA S-83-596.
c. Inside-Outside Plant Mechanical Properties: ICEA S-104-696.
d. Jacket:

1) Cable cordage jacket, fiber, unit, and group color in accordance with TIA-598.
2) Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inch (1 m).

C. Type OFCR, Fiber Optic Conductive Riser; Designation OM1, Multimode Optical Fiber Cable :

1. Acceptable Manufacturers:
   a. Belden
   b. Corning Inc.
   c. L-Com
   d. Optical Cable Corp.
   e. Or equal
2. Additional Characteristics:

a. Construction: TIA-492AAAA; 62.5 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 200 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

3. Options:

a. Configuration: 4 – 48 -fiber, tight buffer, optical fiber cable.
b. Maximum Attenuation: 3.50 dB/km at 850 nm wavelength; 1.5 dB/km at 1300 nm wavelength.

c. Jacket Color: Orange.
d. Armor: Aluminum.

D. Type OFCR, Fiber Optic Conductive Riser; Designation OM2, Multimode Optical Fiber Cable

1. Acceptable Manufacturers:
   a. Belden
   b. Corning Inc.
   c. L-Com
   d. Optical Cable Corp.
   e. Or equal
2. Additional Characteristics:

   a. Construction: TIA-492AAAB; 50 µm core diameter, 125 µm cladding diameter.
   b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

3. Options:

   a. Configuration: 4 - 48-fiber, tight buffer, optical fiber cable.
   b. Maximum Attenuation: 3.50 dB/km at 850 nm wavelength; 1.5 dB/km at 1300 nm wavelength.
   c. Jacket Color: Orange.
   d. Armor: Aluminum.

E. Type OFCR, Fiber Optic Conductive Riser; Designation OM3, Multimode Optical Fiber Cable:

1. Acceptable Manufacturers:
   a. Belden
   b. Corning Inc.
   c. L-Com
   d. Optical Cable Corp.
   e. Or equal
2. Additional Characteristics:

   a. Construction: TIA-492AAAC; 850 nm laser-optimized, 50 µm core diameter, 125 µm cladding diameter.
   b. Minimum Overfilled Modal Bandwidth-Length Product: 1500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.
   c. Minimum Effective Modal Bandwidth-Length Product: 2000 MHz-km at 850 nm wavelength.

3. Options:

   a. Configuration: 4 - 48-fiber, tight buffer, optical fiber cable.
   b. Maximum Attenuation: 3.50 dB/km at 850 nm wavelength; 1.5 dB/km at 1300 nm wavelength.
   c. Jacket Color: Aqua.
   d. Armor: Aluminum.

F. Type OFCR, Fiber Optic Conductive Riser; Designation OM4, Multimode Optical Fiber Cable:

1. Acceptable Manufacturers:
    a. Belden
    b. Corning Inc.
    c. L-Com
    d. Optical Cable Corp.
    e. Or equal
2. Additional Characteristics:

    a. Construction: TIA-492AAAD; 850 nm laser-optimized, 50 µm core diameter, 125 µm cladding diameter.
    b. Minimum Overfilled Modal Bandwidth-Length Product: 3500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.
    c. Minimum Effective Modal Bandwidth-Length Product: 4700 MHz-km at 850 nm wavelength.

3. Options:

    a. Configuration: 4 - 48-fiber, tight buffer, optical fiber cable.
    b. Maximum Attenuation: 3.50 dB/km at 850 nm wavelength; 1.5 dB/km at 1300 nm wavelength.
    c. Jacket Color: Aqua.
    d. Armor: Aluminum.

G. Type OFCR, Fiber Optic Conductive Riser; Designation OS1, Inside-Outside Plant, Single-Mode Optical Fiber Cable

1. Acceptable Manufacturers:
    a. Belden
    b. Corning Inc.
    c. L-Com
    d. Optical Cable Corp.
    e. Or equal
2. Additional Characteristics:

    a. Construction: TIA-492CAAA; 9 µm core diameter, 125 µm cladding diameter.
    b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

3. Options:

    a. Configuration:

        1) 6 - 12-fiber, single loose tube, optical fiber cable.
        2) 24 - 144-fiber, stranded loose tube, optical fiber cable.

    b. Maximum Attenuation: 0.5 dB/km at 1310 nm wavelength; 0.5 dB/km at 1550 nm wavelength.
    c. Jacket Color: Yellow
    d. Armor: Aluminum.

H. Type OFCR, Fiber Optic Conductive Riser; Designation OS2, Inside-Outside Plant, Single-Mode Optical Fiber Cable

1. Acceptable Manufacturers:
   a. Belden
   b. Corning Inc.
   c. L-Com
   d. Optical Cable Corp.
   e. Or equal
2. Additional Characteristics:

   a. Construction: TIA-492CAAB; 9 µm core diameter, 125 µm cladding diameter, with low water peak.
   b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

3. Options:

   a. Configuration:

      1) 6 - 12-fiber, single loose tube, optical fiber cable.
      2) 24 - 144-fiber, stranded loose tube, optical fiber cable.

   b. Maximum Attenuation: 0.5 dB/km at 1310 nm wavelength; 0.5 dB/km at 1550 nm wavelength.
   c. Jacket Color: Yellow.
   d. Armor: Aluminum.

2.3 TYPE OFNP OPTICAL FIBER CABLE

A. Description: This category covers jacketed optical fiber cable for use in vertical runs in plenums, ducts, or other spaces used for environmental air within buildings in accordance with Article 770 of NFPA 70 containing no electrically conductive materials.

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
2. Listing Criteria: UL CCN QAYK; including UL 1651.
3. General Characteristics:

   a. Performance: TIA-568.3.
   b. Inside Plant Mechanical Properties: ICEA S-83-596.
   c. Inside-Outside Plant Mechanical Properties: ICEA S-104-696.
   d. Jacket:

      1) Cable cordage jacket, fiber, unit, and group color in accordance with TIA-598.

2) Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inch (1 m).

C. Type OFNP, Fiber Optic Non-Conductivity Plenum; Designation OM1, Multimode Optical Fiber Cable

1. Acceptable Manufacturers:
   a. Belden
   b. Corning Inc.
   c. L-Com
   d. Optical Cable Corp.
   e. Or equal
2. Additional Characteristics:

   a. Construction: TIA-492AAAA; 62.5 µm core diameter, 125 µm cladding diameter.
   b. Minimum Overfilled Modal Bandwidth-Length Product: 200 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

3. Options:

   a. Configuration: 4 - 48-fiber, tight buffer, optical fiber cable.
   b. Maximum Attenuation: 3.50 dB/km at 850 nm wavelength; 1.5 dB/km at 1300 nm wavelength.
   c. Jacket Color: Orange.

D. Type OFNP, Fiber Optic Non-Conductivity Plenum; Designation OM2, Multimode Optical Fiber Cable:

1. Acceptable Manufacturers:
   a. Belden
   b. Corning Inc.
   c. L-Com
   d. Optical Cable Corp.
   e. Or equal
2. Additional Characteristics:

   a. Construction: TIA-492AAAB; 50 µm core diameter, 125 µm cladding diameter.
   b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

3. Options:

   a. Configuration: 4 - 48-fiber, tight buffer, optical fiber cable.
   b. Maximum Attenuation: 3.50 dB/km at 850 nm wavelength; 1.5 dB/km at 1300 nm wavelength.
   c. Jacket Color: Orange.

E. Type OFNP, Fiber Optic Non-Conductivity Plenum; Designation OM3, Multimode Optical Fiber Cable

1. Acceptable Manufacturers:

a. Belden
b. Corning Inc.
c. L-Com
d. Optical Cable Corp.
e. Or equal

2.

3. Additional Characteristics:

a. Construction: TIA-492AAAC; 850 nm laser-optimized, 50 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 1500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.
c. Minimum Effective Modal Bandwidth-Length Product: 2000 MHz-km at 850 nm wavelength.

4. Options:

a. Configuration: 4 - 48-fiber, tight buffer, optical fiber cable.
b. Maximum Attenuation: 3.50 dB/km at 850 nm wavelength; 1.5 dB/kmat 1300 nm wavelength.
c. Jacket Color: Aqua

F. Type OFNP, Fiber Optic Non-Conductivity Plenum; Designation OM4, Multimode Optical Fiber Cable

1. Acceptable Manufacturers:
a. Belden
b. Corning Inc.
c. L-Com
d. Optical Cable Corp.
e. Or equal
2. Additional Characteristics:

a. Construction: TIA-492AAAD; 850 nm laser-optimized, 50 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 3500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.
c. Minimum Effective Modal Bandwidth-Length Product: 4700 MHz-km at 850 nm wavelength.

3. Options:

a. Configuration: 4 - 48-fiber, tight buffer, optical fiber cable.
b. Maximum Attenuation: 3.50 dB/km at 850 nm wavelength; 1.5 dB/km 1300 nm wavelength.
c. Jacket Color: Aqua

G. Type OFNP, Fiber Optic Non-Conductivity Plenum; Designation OS1, Inside-Outside Plant, Single-Mode Optical Fiber Cable

1. Acceptable Manufacturers:
    a. Belden
    b. Corning Inc.
    c. L-Com
    d. Optical Cable Corp.
    e. Or equal
2. Additional Characteristics:

    a. Construction: TIA-492CAAA; 9 µm core diameter, 125 µm cladding diameter.
    b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

3. Options:

    a. Configuration:

        1) 6 – 12 -fiber, single loose tube, optical fiber cable.
        2) 24 - 144-fiber, stranded loose tube, optical fiber cable.

    b. Maximum Attenuation: 0.5 dB/km at 1310 nm wavelength; 0.5 dB/km at 1550 nm wavelength.
    c. Jacket Color: Yellow

H. Type OFNP, Fiber Optic Non-Conductivity Plenum; Designation OS2, Inside-Outside Plant, Single-Mode Optical Fiber Cable

1. Acceptable Manufacturers:
    a. Belden
    b. Corning Inc.
    c. L-Com
    d. Optical Cable Corp.
    e. Or equal
2. Additional Characteristics:

    a. Construction: TIA-492CAAB; 9 µm core diameter, 125 µm cladding diameter, with low water peak.
    b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

3. Options:

    a. Configuration:

        1) 6 - 12-fiber, single loose tube, optical fiber cable.
        2) 24 - 144-fiber, stranded loose tube, optical fiber cable.

    b. Maximum Attenuation: 0.5 dB/km at 1310 nm wavelength; 0.5 dB/km at 1550 nm wavelength.
    c. Jacket Color: Yellow

2.4 TYPE OFCP OPTICAL FIBER CABLE

A. Description: This category covers jacketed optical fiber cable for use in vertical runs in plenums, ducts, or other spaces used for environmental air within buildings in accordance with Article 770 of NFPA 70 containing noncurrent-carrying electrically conductive materials.

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN QAYK; including UL 1651.
3. General Characteristics:

    a. Performance: TIA-568.3.
    b. Inside Plant Mechanical Properties: ICEA S-83-596.
    c. Inside-Outside Plant Mechanical Properties: ICEA S-104-696.
    d. Jacket:

        1) Cable cordage jacket, fiber, unit, and group color in accordance with TIA-598.
        2) Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inch (1 m).

C. Type OFCP, Fiber Optic Conductive Plenum; Designation OM1, Multimode Optical Fiber Cable:

1. Acceptable Manufacturers:
    a. Belden
    b. Corning Inc.
    c. L-Com
    d. Optical Cable Corp.
    e. Or equal

2. Additional Characteristics:

    a. Construction: TIA-492AAAA; 62.5 µm core diameter, 125 µm cladding diameter.
    b. Minimum Overfilled Modal Bandwidth-Length Product: 200 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

3. Options:

    a. Configuration: 6 fiber, tight buffer, optical fiber cable.
    b. Maximum Attenuation: 3.50 dB/km at 850 nm wavelength; 1.5 dB/km at 1300 nm wavelength.
    c. Jacket Color: Orange.
    d. Armor: Aluminum.

D. Type OFCP, Designation OM2, Multimode Optical Fiber Cable

1. Acceptable Manufacturers:

a. Belden
b. Corning Inc.
c. L-Com
d. Optical Cable Corp.
e. Or equal

2. Additional Characteristics:

a. Construction: TIA-492AAAB; 50 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

3. Options:

a. Configuration: 6 -fiber, tight buffer, optical fiber cable.
b. Maximum Attenuation: 3.50 dB/km at 850 nm wavelength; 1.5 dB/km at 1300 nm wavelength.
c. Jacket Color: Orange.
d. Armor: Aluminum.

E. Type OFCP, Designation OM3, Multimode Optical Fiber Cable

1. Acceptable Manufacturers:
a. Belden
b. Corning Inc.
c. L-Com
d. Optical Cable Corp.
e. Or equal

2. Additional Characteristics:

a. Construction: TIA-492AAAC; 850 nm laser-optimized, 50 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 1500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.
c. Minimum Effective Modal Bandwidth-Length Product: 2000 MHz-km at 850 nm wavelength.

3. Options:

a. Configuration: 6 fiber, tight buffer, optical fiber cable.
b. Maximum Attenuation: 3.50 dB/km at 850 nm wavelength; 1.5 dB/km at 1300 nm wavelength.
c. Jacket Color: Aqua.
d. Armor: Aluminum.

F. Type OFCP, Designation OM4, Multimode Optical Fiber Cable.

1. Acceptable Manufacturers:
a. Belden
b. Corning Inc.

c. L-Com
d. Optical Cable Corp.
e. Or equal

2. Additional Characteristics:

a. Construction: TIA-492AAAD; 850 nm laser-optimized, 50 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 3500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.
c. Minimum Effective Modal Bandwidth-Length Product: 4700 MHz-km at 850 nm wavelength.

3. Options:

a. Configuration: 6-fiber, tight buffer, optical fiber cable.
b. Maximum Attenuation: 3.50 dB/km at 850 nm wavelength; 1.5 dB/km at 1300 nm wavelength.
c. Jacket Color: Aqua.
d. Armor: Aluminum.

G. Type OFCP, Designation OS1, Inside-Outside Plant, Single-Mode Optical Fiber Cable

1. Acceptable Manufacturers:
a. Belden
b. Corning Inc.
c. L-Com
d. Optical Cable Corp.
e. Or equal

2. Additional Characteristics:

a. Construction: TIA-492CAAA; 9 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

3. Options:

a. Configuration:

1) 6-fiber, single loose tube, optical fiber cable.

b. Maximum Attenuation: 0.5 dB/km at 1310 nm wavelength; 0.5 dB/km at 1550 nm wavelength.
c. Jacket Color: Yellow.
d. Armor: Aluminum.

H. Type OFCP, Designation OS2, Inside-Outside Plant, Single-Mode Optical Fiber Cable:

1. Acceptable Manufacturers:
a. Belden

b. Corning Inc.
c. L-Com
d. Optical Cable Corp.
e. Or equal

2. Additional Characteristics:

a. Construction: TIA-492CAAB; 9 µm core diameter, 125 µm cladding diameter, with low water peak.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

3. Options:

a. Configuration:

1) 6-fiber, single loose tube, optical fiber cable.

b. Maximum Attenuation: 0.5 dB/km at 1310 nm wavelength; 0.5 dB/km at 1550 nm wavelength.
c. Jacket Color: Yellow.
d. Armor: Aluminum.

2.5 TYPES OFN AND OFNG OPTICAL FIBER CABLE

A. Description: This category covers jacketed optical fiber cable for general use within buildings in accordance with Article 770 of NFPA 70 containing no electrically conductive materials.

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN QAYK; including UL 1651.
3. General Characteristics:

a. Performance: TIA-568.3.
b. Inside Plant Mechanical Properties: ICEA S-83-596.
c. Inside-Outside Plant Mechanical Properties: ICEA S-104-696.
d. Jacket:

1) Cable cordage jacket, fiber, unit, and group color in accordance with TIA-598.
2) Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inch (1 m).

C. Types OFN and OFNG, Designation OM2, Multimode Optical Fiber Cable

1. Acceptable Manufacturers:
a. Belden

b. Corning Inc.
c. L-Com
d. Optical Cable Corp.
e. Or equal

2. Additional Characteristics:

a. Construction: TIA-492AAAB; 50 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

3. Options:

a. Configuration: 6-fiber, tight buffer, optical fiber cable.
b. Maximum Attenuation: 3.50 dB/km at 850 nm wavelength; 1.5 dB/km at 1300 nm wavelength.
c. Jacket Color: Orange.

D. Types OFN and OFNG, Designation OS1, Inside-Outside Plant, Single-Mode Optical Fiber Cable:

1. Acceptable Manufacturers:
a. Belden
b. Corning Inc.
c. L-Com
d. Optical Cable Corp.
e. Or equal

2. Additional Characteristics:

a. Construction: TIA-492CAAA; 9 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

3. Options:

a. Configuration:

1) 6-fiber, single loose tube, optical fiber cable.

b. Maximum Attenuation: 0.5 dB/km at 1310 nm wavelength; 0.5 dB/km at 1550 nm wavelength.
c. Jacket Color: Yellow.

E. Types OFN and OFNG, Designation OS2, Inside-Outside Plant, Single-Mode Optical Fiber Cable:

1. Acceptable Manufacturers:
a. Belden
b. Corning Inc.
c. L-Com

d. Optical Cable Corp.
e. Or equal

2. Additional Characteristics:

a. Construction: TIA-492CAAB; 9 µm core diameter, 125 µm cladding diameter, with low water peak.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

3. Options:

a. Configuration:

1) 6-fiber, single loose tube, optical fiber cable.

b. Maximum Attenuation: 0.5 dB/km at 1310 nm wavelength; 0.5 dB/km at 1550 nm wavelength.
c. Jacket Color: Yellow.

2.6 TYPES OFC AND OFCG OPTICAL FIBER CABLE

A. Description: This category covers jacketed optical fiber cable for general use within buildings in accordance with Article 770 of NFPA 70 containing noncurrent-carrying electrically conductive materials.

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN QAYK; including UL 1651.
3. General Characteristics:

a. Performance: TIA-568.3.
b. Inside Plant Mechanical Properties: ICEA S-83-596.
c. Inside-Outside Plant Mechanical Properties: ICEA S-104-696.
d. Jacket:

1) Cable cordage jacket, fiber, unit, and group color in accordance with TIA-598.
2) Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inch (1 m).

C. Types OFC and OFCG, Designation OM2, Multimode Optical Fiber Cable

1. Acceptable Manufacturers:
a. Belden
b. Corning Inc.
c. L-Com

d. Optical Cable Corp.
e. Or equal

2. Additional Characteristics:

a. Construction: TIA-492AAAB; 50 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

3. Options:

a. Configuration: 6-fiber, tight buffer, optical fiber cable.
b. Maximum Attenuation: 3.50 dB/km at 850 nm wavelength; 1.5 dB/km at 1300 nm wavelength.
c. Jacket Color: Orange.
d. Armor: Aluminum.

D. Types OFC and OFCG, Designation OS1, Inside-Outside Plant, Single-Mode Optical Fiber Cable:

1. Acceptable Manufacturers:
a. Belden
b. Corning Inc.
c. L-Com
d. Optical Cable Corp.
e. Or equal

2. Additional Characteristics:

a. Construction: TIA-492CAAA; 9 µm core diameter, 125 µm cladding diameter.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

3. Options:

a. Configuration:

1) 6-fiber, single loose tube, optical fiber cable.

b. Maximum Attenuation: 0.5 dB/km at 1310 nm wavelength; 0.5 dB/km at 1550 nm wavelength.
c. Jacket Color: Yellow.
d. Armor: Aluminum.

E. Types OFC and OFCG, Designation OS2, Inside-Outside Plant, Single-Mode Optical Fiber Cable

1. Acceptable Manufacturers:
a. Belden
b. Corning Inc.
c. L-Com

d. Optical Cable Corp.
e. Or equal

2. Additional Characteristics:

a. Construction: TIA-492CAAB; 9 µm core diameter, 125 µm cladding diameter, with low water peak.
b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.

3. Options:

a. Configuration:

1) 6-fiber, single loose tube, optical fiber cable.

b. Maximum Attenuation: 0.5 dB/km at 1310 nm wavelength; 0.5 dB/km at 1550 nm wavelength.
c. Jacket Color: Yellow.
d. Armor: Aluminum.

2.7 OPTICAL FIBER CABLE HARDWARE

A. Acceptable Manufacturers:
a. Belden
b. Corning Inc.
c. Panduit
d. Legrand US
e. Or equal

B. Performance Criteria:

1. Fiber Optic Connector Intermate ability Standard (FOCIS) specifications of TIA-604 series.
2. TIA-568.3.

C. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

D. Patch Cords: Factory-made, dual-fiber cables in 36 inch (900 mm) lengths.

E. Connector Type: Type SC complying with TIA-604-3, Type ST complying with TIA-604-2, Type LC complying with TIA-604-10, Type MT-RJ complying with TIA-604-12, Type MPO complying with TIA-604-5 connectors.

F. Plugs and Plug Assemblies:

1. Male; color-coded modular telecommunications connector designed for termination of single optical fiber cable.
2. Insertion loss not more than 0.25 dB.
3. Marked to indicate transmission performance.

G. Jacks and Jack Assemblies:

1. Female; quick-connect, simplex and duplex; fixed telecommunications connector designed for termination of single optical fiber cable.
2. Insertion loss not more than 0.25 dB.
3. Marked to indicate transmission performance.
4. Designed to snap-in to patch panel or faceplate.

2.8 SOURCE QUALITY CONTROL

A. Factory Tests and Inspections:

1. Test and inspect multimode optical fiber cables, by, or under supervision of, qualified electrical testing laboratory recognized by authorities having jurisdiction, in accordance with TIA-526-14 and TIA-568.3 before delivering to site. Affix label with name and date of qualified electrical testing laboratory's certification of system compliance.
2. Test and inspect pre-terminated optical fiber cable assemblies, by, or under supervision of, qualified electrical testing laboratory recognized by authorities having jurisdiction, in accordance with TIA-526-14 and TIA-568.3 before delivering to site. Affix label with name and date of qualified electrical testing laboratory's certification of system compliance.

B. Nonconforming Work:

1. Cables that do not pass tests and inspections will be considered defective.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate backbone cabling with protectors and demarcation point provided by communications service provider.

3.2 SELECTION OF OPTICAL FIBER TYPE

A. Installed in Vertical Shaft or Floor-to-Floor Riser:

1. Nonconductive:

a. Type OFNR or Type OFNP.
b. Type OFNP in metallic conduit.

2. Conductive:

    a. Type OFCR or Type OFCP.
    b. Type OFCR or Type OFCP in metallic conduit.

B. Installed in Plenum, Duct, or Other Space Handling Environmental Air:

1. Nonconductive:

    a. Type OFNP.
    b. Type OFNR or Type OFNP in metallic conduit.

2. Conductive:

    a. Type OFCP.
    b. Type OFCR or Type OFCP in metallic conduit.

C. Installed in Location Other Than Riser or Plenum:

1. Nonconductive: Type OFNR or Type OFNP in metallic conduit.
2. Conductive: Type OFCR or Type OFCP in metallic conduit.

3.3 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

A. Optical fiber backbone cabling system must provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters may not be used as part of backbone cabling.

C. Comply with BICSI N1, NECA NEIS 1, and NECA NEIS 301.

D. Backbone cabling system must comply with transmission standards in TIA-568.1.

E. Telecommunications Pathways and Spaces: Comply with TIA-569.

F. Wiring Methods:

1. Not in Raceway: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
2. In Raceway: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

    a. Install plenum cable in environmental airspaces, including plenum ceilings.
    b. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."

3. In Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

G. Optical Fiber Cabling Installation:

1. Comply with TIA-568.1 and TIA-568.3.
2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
3. Terminate all cables; no cable may contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inch (760 mm) and not more than 6 inch (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps may not be used for heating.
9. In communications equipment room, provide 10 ft (3 m) long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

H. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Cable may not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

I. Installation of Cable Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after flooring system has been installed in raised floor areas.
3. Coil cable 6 ft (1.8 m) long not less than 12 inch (300 mm) in diameter below each feed point.

J. Group connecting hardware for cables into separate logical fields.

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569, Annex A, "Firestopping."

C. Comply with BICSI ITSIMM, "Firestopping" Chapter.

3.5 GROUNDING

A. Install grounding in accordance with BICSI ITSIMM, "Grounding (Earthing), Bonding, and Electrical Protection" Chapter.

B. Comply with TIA-607 and NECA/BICSI-607.

C. Locate grounding bus bar to minimize length of bonding conductors. Fasten to wall allowing at least 2 inch (50 mm) clearance behind grounding bus bar. Connect grounding bus bar with minimum 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to grounding bus bar, using not smaller than 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Administration Class: Class 2 for inside buildings. Class 4 for multi-site applications.
2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Paint and label colors for equipment identification must comply with TIA-606 for Class 2 and Class 4 level of administration including optional identification requirements of this standard.

C. Comply with requirements in Section 271523 "Communications Optical Fiber Horizontal Cabling" for cable and asset management software.

D. Cable Schedule: Install in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish electronic copy of final comprehensive schedules for Project.

E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

F. Cable and Wire Identification:

1. Label each cable within 4 inch (100 mm) of each termination and tap, where it is accessible in cabinet or junction or outlet box, and elsewhere as indicated.

2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 ft (4.5 m).
4. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use different color for jacks and plugs of each service.

G. Labels must be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606, for the following:

1. Flexible vinyl or polyester that flexes as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Field tests and inspections must be witnessed by Tenant and Authorities having jurisdiction.

B. Tests and Inspections:

1. Visually inspect optical fiber jacket materials for qualified electrical testing laboratory certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Optical Fiber Cable Tests:

    a. Test instruments must meet or exceed applicable requirements in TIA-568.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    b. Link End-to-End Attenuation Tests:

        1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in one direction in accordance with TIA-526-14, Method B, One Reference Jumper.
        2) Attenuation test results for backbone links must be less than 2.0 dB. Attenuation test results must be less than those calculated in accordance with equation in TIA-568.1.

C. Nonconforming Work:

1. Cables will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective cables and retest.

D. Collect, assemble, and submit test and inspection reports.

1. Data for each measurement must be documented.
2. Data for field quality-control report submittals must be printed in summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from instrument to computer, saved as text files, and printed and submitted.

E. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

END OF SECTION 271323

SECTION 312100 - EARTH MOVING FOR BUILDINGS AND STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade.
3. Excavating and backfilling for buildings and structures.
4. Drainage course for concrete slabs-on-grade.
5. Subsurface drainage backfill for walls and trenches.
6. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Requirements:
1. Section 311000 "Site Clearing" for site stripping, grubbing, stripping topsoil, and removal of above- and below-grade improvements and utilities.
2. Section 315000 "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.

1.2 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: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer 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: Aggregate layer 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.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Bulk Excavation: Excavation more than 10 feet (3 m) in width and more than 30 feet (9 m) in length.

3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, will be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock:

1. Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. (0.76 cu. m) for bulk excavation or 3/4 cu. yd. (0.57 cu. m) for footing, trench, and pit excavation that cannot be removed by rock-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

a. Equipment for Footing, Trench, and Pit Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- (1065-mm-) maximum-width, short-tip-radius rock bucket; rated at not less than 138-hp (103-kW) flywheel power with bucket-curling force of not less than 28,700 lbf (128 kN) and stick-crowd force of not less than 18,400 lbf (82 kN) with extra-long reach boom.
b. Equipment for Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp (172-kW) flywheel power and developing a minimum of 47,992-lbf (213.3-kN) breakout force with a general-purpose bare bucket.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other fabricated stationary features constructed above or below the ground surface.

J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.3 PREINSTALLATION MEETINGS

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

1. Review methods and procedures related to earthmoving, including, but not limited to, the following:

a. Personnel and equipment needed to make progress and avoid delays.
b. Coordination of Work with utility locator service.
c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
d. Extent of trenching by hand or with air spade.
e. Field quality control.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Controlled low-strength material, including design mixture.
3. Geofoam.
4. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:

1. Geotextile: 12 by 12 inches (300 by 300 mm).
2. Warning Tape: 12 inches (300 mm) long; of each color.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D2487.
2. Laboratory compaction curve according to ASTM D1557.

C. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.6 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving 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 Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.

C. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 015000 "Temporary Facilities and Controls" and Section 311000 "Site Clearing" are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D2487, or a combination of these groups; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487, or a combination of these groups.

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 D2940/D2940M; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 95 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

H. Drainage Course: Narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and zero to 5 percent passing a No. 8 (2.36-mm) sieve.

I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and zero to 5 percent passing a No. 4 (4.75-mm) sieve.

J. Sand: ASTM C33/C33M; fine aggregate.

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; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability:

    a. Class 2; AASHTO M 288.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability:

    a. Class 2; AASHTO M 288.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

A. Controlled Low-Strength Material: Self-compacting, flowable concrete material produced from the following:

1. Portland Cement: ASTM C150/C150M, Type I.
2. Fly Ash: ASTM C618, Class C or F.
3. Normal-Weight Aggregate: ASTM C33/C33M, 3/4-inch (19-mm) nominal maximum aggregate size.
4. Water: ASTM C94/C94M.
5. Air-Entraining Admixture: ASTM C260/C260M.

B. Produce conventional-weight, controlled low-strength material with 80-psi (550-kPa) compressive strength when tested according to ASTM C495/C495M.

2.4 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.

3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

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 earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Provide dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

C. 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 trenches as temporary drainage ditches.

D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

3.3 EXPLOSIVES

A. Explosives:

1. Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil

materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:

    a. 24 inches (600 mm) outside of concrete forms other than at footings.
    b. 12 inches (300 mm) outside of concrete forms at footings.
    c. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
    d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
    e. 6 inches (150 mm) beneath bottom of concrete slabs-on-grade.
    f. 6 inches (150 mm) beneath pipe in trenches and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). 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.
2. Pile Foundations: Stop excavations 6 to 12 inches (150 to 300 mm) above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. 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.

B. 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 (300 mm) higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches (300 mm) each side of pipe or conduit.

C. Trench Bottoms:

1. Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

    a. For pipes and conduit less than 6 inches (150 mm) in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
    b. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
    c. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
    d. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.7 SUBGRADE INSPECTION

A. Notify Engineer when excavations have reached required subgrade.

B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with a 10 ton vibratory roller to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction.
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, 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, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Engineer.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by 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, 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. Place backfill on subgrades free of mud, frost, snow, or ice.

B. 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.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches (450 mm) of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

D. Backfill voids with satisfactory soil while removing shoring and bracing.

E. Initial Backfill:

1. Soil Backfill: Place and compact initial backfill of subbase material, free of particles larger than 1 inch (25 mm) in any dimension, to a height of 12 inches (300 mm) over the pipe or conduit.

a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

F. Final Backfill:

1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

G. Warning Tape: Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

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 as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use 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 (200 mm) in loose depth for material compacted by heavy compaction equipment and not more than 4 inches (100 mm) 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 D1557:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.15 SUBSURFACE DRAINAGE

A. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch (150-mm) course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches (300 mm) of filter material, placed in compacted layers 6 inches (150 mm) thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches (150 mm).

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D1557.

B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches (300 mm) of final subgrade, in compacted layers 6 inches (150 mm) thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches (150 mm).

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D1557
2. Place and compact impervious fill over drainage backfill in 6-inch- (150-mm-) thick compacted layers to final subgrade.

3.16 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

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 (150 mm) or less in compacted thickness in a single layer.
3. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D698.

3.17 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
2. Determine that fill material classification and maximum lift thickness comply with requirements.
3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

E. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2937, and ASTM D6938, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. (186 sq. m) or less of paved area or building slab but in no case fewer than three tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet (30 m) or less of wall length but no fewer than two tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet (46 m) or less of trench length but no fewer than two tests.

F. 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 materials to depth required; recompact and retest until specified compaction is obtained.

3.18 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; 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.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

PART 4 - MEASUREMENT, QUANITTY & PAYMENT

Cost for work specified in this section shall be paid for under the bid form line items for which they are a part. Costs shall include all required earth moving for buildings and structures. This includes but is not limited to excavating and filling for rough grading the site, preparing subgrades for slabs-on-grade, excavating and backfilling for buildings and structures, drainage course for concrete slabs-on-grade, subsurface drainage backfill for walls and trenches, and excavating and backfilling trenches for utilities and pits for buried utility structures.

END OF SECTION 312000

SECTION 312319

DEWATERING

SECTION 1 – GENERAL

1.01 DESCRIPTION

Dewatering of trenches and excavations.

SECTION 2 – MATERIALS

2.01 All materials shall be adequate for the proposed work and shall comply with the requirements of the contract documents.

SECTION 3 - EXECUTION

3.01 PERFORMANCE

1. Provide and maintain ample means and devices (including spare units for use in case of breakdown) to promptly remove and dispose of water or sewage entering excavations or trenches.

2. Keep excavations and structures dry until all work is completed and pipe joints are satisfactorily installed, and to extent that introduction of water in system will not damage either new or existing structures.

3. Dispose of water in suitable manner, without damage to work site or adjacent property.

4. If groundwater and subsoil conditions along line of work are such that a stable, hard trench or excavation bottom for the pipe or structure cannot be achieved by trench pump, bailing or other methods, the contractor shall provide alternate means and methods for trench dewatering without additional compensation.

5. If the contractor utilizes a well point system for dewatering, a signed and sealed well point system design, prepared by a professional engineer licensed in the State of New Jersey, shall be provided by the contractor as part of the submittal process.

END OF SECTION

SECTION 312333

UTILITY EXCAVATION AND BACKFILL

SECTION 1 – GENERAL

1.01 DESCRIPTION

A. Excavation and backfill shall include clearing and grubbing and excavating and backfilling for all utilities, and all appurtenances at the required locations, as shown on the plans and specifications for all materials of whatsoever nature encountered.

SECTION 2 – MATERIALS

2.01 MATERIALS

A. The Contractor shall, at his expense, make such test pits and borings along the line and site of the work to satisfy himself regarding the character of the various strata of sub-surface materials and the amount of ground water that may be encountered in the course of construction and shall bid accordingly and the unit lump sum prices bid for the various pipes or structures requiring excavation shall include the difficulties to be encountered in excavation. Excavation shall include all materials excavated, encountered, including but not limited to rock, earth, shale, quicksand, gravel, sand, cinders, broken stone, concrete, paving, filled material, etc., and all miscellaneous excavation not herein specified and classified.

B. Backfill material from on-site excavation:

All on-site backfill materials shall be subject to the approval of the Engineer, and to the following requirements.

1. Free from deleterious substances, stumps, brush, weeds, roots, sod, rubbish, garbage and matter that may decay.

2. Backfill to a height of two (2) feet above the top of the pipes, culverts and other structures with material free from stones or rock fragments larger than two inches (2") in greatest dimension, or as directed by Engineer.

3. Free of large rocks or lumps that, in the opinion of the Engineer, may create voids or prevent proper compaction.

C. Stone for trench stabilization and bedding:

Trench stabilization material for bedding under pipes and structures shall be broken stone conforming to Section 901.03.01 of the Standard Specifications, and meeting the gradation specified in Table 901.03-1. Size shall be No. 57.

D. Select backfill (if and where directed) for pipes shall be designated as I-13 and meet all the requirements of Section 901.11 of the Standard Specifications and meeting the gradation specified in Table 901.11-1.

SECTION 3 - EXECUTION

A. **General Excavation** - Excavation of all materials of whatsoever nature encountered shall be made to the lines and grades shown on the drawings, or as may be necessary to fully carry out the intent of the drawings, and of these specifications, where no grades are indicated or described.

Surfaces of excavations in earth, exposed in the finished work, both level and sloped, shall be excavated in planes four inches lower than the finished surfaces, measured perpendicularly to the plans, and shall be brought up to the finished surfaces with 4" top soil as specified elsewhere. Finished surfaces shall be true to line and grade and shall be dressed to even planes. Unless otherwise shown or stated on the drawings, all exposed slopes excavated in earth shall be one vertical to two horizontal. Slopes shall be kept true to line and grade during the progress of the work, and should any slope be scoured by storm water, or disturbed or should any excavation be scoured or disturbed before final payment is made, the Contractor shall promptly restore the slope or excavation so scoured, gullied or otherwise disturbed to line and grade before final payment is made. No additional compensation will be paid the Contractor by reason of the encountering of any unusual or unexpected subsoil conditions.

Where required, the Contractor shall provide sheathing and shoring to maintain the stability of side slopes or limit the width of excavation so not to disturb adjacent structures paving or utilities at no additional cost to the Owner.

B. **Excavating Trenches, etc.** - In excavating for all pipes, inlets and manholes, the trenches between the lines of sheathing, if sheathing is used, must be of sufficient width to permit the work to be constructed in the manner and of the size specified. All excavating shall be confined within the narrowest possible limit and made as nearly as possible in a vertical line, and any sheathing, shoring, bracing or timbering which is necessary to obtain this result shall be done as hereinafter specified. Sloped banks will not be permitted except where permitted by the Engineer.

The maximum width of trench at top of pipe measured to undisturbed earth shall be the greater of the pipe outside diameter plus 16 inches or the pipe outside diameter times 1.25 plus 12 inches.

Should sloped banks be permitted, contractor shall, at no extra charge to Owner, provide temporary surface over width of disturbed area of street to provide for the unrestricted use of traffic immediately upon completion of backfill. Such temporary surfacing shall be stone, gravel or as required to permit traffic immediately.
All trenches shall be excavated on the lines designated by the Engineer and to the grades and depths necessary for the laying of pipes at the grades given by him. The lines and grades given by the Engineer shall, in general, consist of a benchmark for elevation control and a baseline and from this point on, contractor shall lay out his own work and build. Where, in the opinion of the Engineer, the original depth is sufficiently compact and solid for the foundation of the work, the bottom of the trench shall be excavated to conform to the external form of the pipe and under each bell or joint, unless the pipe is laid on a plank foundation, the trench shall be so hollowed out as to allow the body of the pipe to have a bearing throughout on the trench bottom and to provide ample room for the making of joint. In case a trench be excavated at any place below given grade excepting at pipe joints, it shall be refilled to the proper grades in the manner hereinafter specified. Unless otherwise specified, all excavation shall be performed by the open cut method.

C. **Unauthorized Excavation -** Special care shall be taken to prevent the movement of disturbances of earth under the foundation of the pipelines, manholes and other structures by providing adequate sheathing and bracing. Where the excavation is carried beyond or below the lines and grades given by the Engineer, or wherever the Engineer shall determine that any material has been loosened or disturbed sufficiently to reduce its supporting power, remove all such loosened material and refill all such excavated space to grade with sand or loam thoroughly rammed, in such manner as may be directed by the Engineer in order to ensure the adequate support and stability of the pipeline and other structures. All excavation and any other operation shall be confined to the width of the right-of-ways available.

D. **Additional Excavation** - If material satisfactory for foundations is not found at the elevation of grade, or in case it is found undesirable or necessary to excavate to additional depth, the excavation shall be carried to such additional depth as the Engineer may direct, and refill with compacted sand, washed stone or washed gravel, by the Contractor at no extra cost to the Owner.

E. **Tunneling -** No tunneling will be allowed except by permit from the Engineer. When tunneling, excavate the materials to cross sections as may be designated by the Engineer.

F. **Amount of Trench to be Opened -** The Engineer shall have the right to limit the amount of trench which shall be opened in advance of the completed pipeline and also the amount of trench left unfilled.

Unless otherwise specified, not more than three hundred feet of trench shall be opened or partly opened at any one time in one operation. Adequate provisions shall be made for the use of cross walks and driveways. Provide and maintain all necessary barricades and lights.

G. **Materials Excavated** - The materials excavated shall be laid compactly on the side of the trench or excavation and kept trimmed as to be of as little inconvenience as possible to traveling public and to adjoining tenants. Where the streets are paved, the paving materials shall be kept separate from the other materials excavated. All streets shall be kept open for travel unless otherwise directed by the Engineer.

H. **Removal of Excavated Materials** - The Contractor shall not, without permission from the Engineer, remove from the line of the work any excavated materials which may be suitable for filling the trench or excavation until the same has been refilled. All excess excavation shall remain the property of the Owner and shall be disposed of at the location so designated by the Owner within the limits of the site at the Contractor's expense. However, if the Owner has no real need for this excess excavation, or if the material is unsuitable, it shall be the Contractor's responsibility to dispose of said material at no expense to the Owner. The disposal site shall be one approved by the NJDEP.

I. **Shoring and Sheathing -** All faces of excavation shall be properly sheeted, timbered and braced where necessary to furnish suitable dry and safe working conditions acceptable to the Engineer, to preserve the load carrying capacity of the soil, to keep the excavation within the narrowest possible limit to protect any structure or paving adjacent to or close to the trenches, or work of excavation from damages. Bracing shall be so arranged so as not to place any stress on portions of the completed work until the general construction thereof has proceeded far enough to provide the necessary strength as determined by the Engineer.

Any damage to the pipelines or structures occurring through settlement, water or earth pressure, slides, caves or other causes shall be repaired by the Contractor at no cost to the Owner.

The Contractor shall include in the unit prices bid for the various items the cost involved in the shoring, sheathing, bracing and timbering and the maintenance, etc. of the trenches and other excavation during construction. The Contractor shall be held responsible for the protection of all subsurface and above-ground utilities, adjacent structures, buildings, curbs, sidewalks and street pavement from any settlement, destruction, or damage and for the maintenance of same during construction and for any repair, replacement or restoration of same without cost therefore to the Owner, resulting from the installation of the water mains sewer mains, sewer services and water services or other structures under this contract from the time of completion for a period of two years thereafter to the satisfaction of the Owner.

The Contractor shall be held responsible for the protection of the foregoing described adjacent structures and he alone shall decide upon the advisability of removing any of the sheathing, shoring, bracing or timbering. The Contractor shall, however, notify the Engineer of the removal of any of the sheathing, shoring, bracing or timbering, but such notification is not to be construed as relieving the Contractor of his obligation and responsibility to adequately safeguard said adjacent structure, nor shall it relieve the Contractor of the liability for claims for damage incidental thereto.

All sheathing and shoring left permanently in the excavation shall be cut out at a point 18" below the ground. There shall be no payment for sheathing or shoring left in place, but the cost of same shall be included in the unit price bid for the various sewer lines.

J. **Removal of Water -** Maintain and provide at all times during construction ample means and device which shall promptly remove and properly dispose of all water or sewage entering the excavation and structures, until all work to be built therein is completed.

Dispose of the water from the trenches and excavation in a suitable manner, without damage to adjacent property and in no case unless by special permission of the Engineer, shall water be allowed to run through the new pipes.

Furnish all necessary machinery, power and labor to pump, bail or otherwise remove any water which may be found or shall accumulate in the trenches or other excavation and shall perform all work necessary to keep them clear of water while the work is under construction.

If the ground water and subsoil conditions along the line of the work are such that the Contractor cannot successfully handle the ditch water and provide a stable, hard trench bottom by ordinary trench pumping and bailing, the Contractor shall furnish and provide the necessary equipment, power and labor to employ the well point method of trench dewatering without additional compensation. All pipe, joint and concrete must be installed under absolutely dry conditions.

K. **Backfilling** - The backfilling of the trench will be filled by using properly compacted, common earth material. If sufficient earth cannot be obtained to completely fill the trenches, the Contractor shall use Select Backfill as defined in the Section.

Should excavated material be clay that will not consolidate by ordinary methods of backfilling, it shall be removed from site and replaced with granular material capable of quick compaction, the cost of said material to be included in the price bid.

The space between the pipe and the bottom and sides of the trench shall be backfilled by hand and thoroughly tamped with a light hand tamper, as fast as placed. The pipe shall then be covered by hand to a depth of at least one foot above the top of pipe and at least one man shall be engaged in tamping for each man engaged in shoveling into the trench. At this point on, in trenches and all other excavations, the material may be machine backfilled with backfill continuing in lifts not to exceed 12 inches. Each lift shall be thoroughly compacted using mechanical tampers or other methods as approved by the Engineer.

Contractor is hereby forewarned that he is responsible for any settlement of trench and excavation and the results thereof which may occur during the maintenance period following acceptance of the work.

During the backfill procedure, the soil compaction shall conform to not less than the following percentage of the maximum dry density:

1. Structures & Building Areas – 95%
2. Lawns & Unpaved Areas – 90%
3. Pavement, Driveways, & Walkway Areas – 95%

L. **Borrow Fill Material -** Should there be insufficient material (only if and where directed by the Engineer) to provide suitable material for backfilling and embankment, the Contractor, if and where directed by the Engineer, shall obtain such material elsewhere, transport it to the work site and deposit it therein as described in these specifications and shown on the drawings. Borrow materials shall be subject to approval of the Engineer. Borrow shall be free of organic inclusions and shall be gravelly sand or sandy gravel, fairly well graded, and conforming to Section 203 of the Standard Specifications, except as modified by the supplemental requirements below:

1. Containing no rocks or lumps over six inches in greatest dimension.
2. Composed of soil aggregate, or soil aggregate and rock. The portion passing the four inch sieve shall contain not more than fifteen percent (15%) by weight of material passing the number 200 sieve. When composed of soil aggregate and rock, the proportion of soil aggregate shall not be less than that required to fill all the rock voids.

During the backfill procedure, the soil compaction shall conform to not less than the following percentage of the maximum dry density:

1. Structures & Building Areas - 95%
2. Lawns & Unpaved Areas - 93%
3. Pavement, driveways & walkway area - 95%

M. **Temporary Trench Finish -** In completing work of backfilling the trench, the material shall be carefully placed to conform to the adjacent street surfaces, allowing, however, a slight crown over the trench area to allow for settlement but not sufficient to prevent the use of the street across the trench area by traffic. As settlement occurs, refill and regrade the temporary trench finish with suitable hard material and continue to maintain the surface until such time as the permanent repaving shall be allowed by the Engineer. Allowance repaving by Engineer shall not relieve Contractor of his responsibility for settlement.
The maintenance of trenches shall be continuous by Contractor in such a manner as to keep all streets passable for both pedestrians and vehicular traffic. Cleanup shall be continuous as

work progresses. Contractor shall control any dirt or dust by calcium chloride, etc. as necessary and required at Contractor's expense.

N. **Foundations -** Use every precaution in the excavation for the pipelines, manholes and other structures to protect the natural foundations upon which the work is to be built. Special care must be taken so as not to disturb the finished grade any more than is absolutely necessary. If and where required and directed by the Engineer, support the pipelines by concrete cradle in accordance with the general design and dimensions to be furnished by the Engineer or upon plank foundation.

O. **Interference with Existing Structure or Utilities -** In excavating or backfilling, care must be taken not to injure any gas, water, sewer, electric or telephone conduits or other pipes, conduits or structures. The locations will be made by the Engineer and in locating, he shall avoid interference with existing utilities as far as possible. Contractor shall, at his expense, sling, shore-up and secure and maintain a continuous flow in utilities and shall repair any damage done to them and shall keep them in repair until final acceptance of completed work, leaving them in as good a condition as when uncovered. Where it is either necessary or advisable to locate existing substructures in advance of or during actual construction of the work, the Contractor shall cooperate with the Engineer and furnish without cost to the Owner such labor and equipment as may be required to locate any existing subsurface utilities or structures. No payment will be made for delays to Contractors due to interference with utilities.

The Contractor shall, in advance of construction, obtain all available information as to location of existing underground utilities, service, etc. and will be held responsible for damage done by him to underground structures injured in construction.

P. **Protection of Street Surfaces -** The Contractor shall carefully plank, or otherwise protect all street surfaces, gutters, curbs, and sidewalks before moving any heavy equipment, machinery, tractor or truck over the same. He will be held fully responsible for all damage of every kind which may be incurred by the various surfaces and the Contractor shall repair or rebuild the surfaces as specified for the various surfaces elsewhere herein the specifications except that no payment will be made by the Owner to the Contractor for repair or rebuilding of the surfaces outside the trench areas. The surfaces repaired shall be equal to or superior to the surfaces damaged.

. **Restoration of Rights-of-Ways, etc. -** Where pipelines are constructed along the rights-of-ways, etc., the same shall be restored to their original condition. Sod, topsoil, flowers and shrubbery, if any, shall be carefully removed and replaced or, if damaged, shall be carefully removed and replaced. Trees shall be protected and suffer no damage. Utility poles shall be adequately braced in accordance with the utilities regulations.

R. **Detours, etc. -** Contractor shall, where necessary , provide and erect all detour signs and maintain necessary barricades and lights. He shall confer with the local police chief and fire chief before blocking any street.

Contractor shall construct temporary bridges in order to provide access to driveways, etc. when required.

S. **State Highways -** Contractor shall fully comply with all regulations of the New Jersey Department of Transportation covering street openings when any work within right-of-way

lines of any State Highway right-of-ways or property. Permit shall be secured by the Contractor.

T. **County Roads -** Contractor shall investigate and conform with all regulations of County Department having jurisdiction over street opening when performing any work in County roads. Permits for road opening shall be secured by the Contractor and any inspection services required by County shall be paid for by Contractor.

U. **Railroad Crossings -** Contractor shall fully comply with all regulations of the Railroad Company when performing any work within Railroad right-of-ways. Permits shall be secured by Contractor.

END OF SECTION

SECTION 315000

EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions as included in these specifications, apply to this Section.

1.2 SUMMARY

A. This Section includes temporary excavation support and protection systems; including but not limited to the following.

1. Design of bracing, shoring, and underpinning.
2. Preparation of Construction Sequence.

B. Related Sections include the following:

1. Section 017100 – Cleaning and Restoration.
2. Section 024000 – Demolition.
3. Section 310000 – Excavation and Backfill.
4. Section 030000 - Concrete.

1.3 PERFORMANCE REQUIREMENTS

A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting existing structures, excavation sidewalls, and of resisting soil and hydrostatic pressure and superimposed and construction loads.

1. Provide professional engineering services needed to assume engineering responsibility, including preparation of Shop Drawings and a comprehensive engineering analysis by a qualified professional engineer.
2. Prevent surface water from entering excavations by grading, dikes, or other means.
3. Install excavation support and protection systems without damaging existing buildings, pavements, and other improvements adjacent to excavation.

1.4 SUBMITTALS

A. Shop Drawings: Prepared by or under the supervision of a qualified professional engineer for excavation support and protection systems.

1. Include Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation. Professional engineer shall be licensed in the State of New Jersey.

2. Include Design Calculations signed and sealed by the qualified professional engineer responsible for their preparation. Professional engineer shall be licensed in the State of New Jersey.

3. The design engineer shall prepare a construction sequence to detail the methods and sequence of the required excavation support and protection.

B. Qualification Data: For Installer and professional engineer.

C. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems.

1.5 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by the Engineer and then only after arranging to provide temporary utility services according to requirements indicated.

B. Project-Site Information: A plan of the existing building and proposed area of excavation is included as part of these specifications. A geotechnical report of the existing soil conditions, which may be required by the excavation support and protection design engineer, shall be provided by the contractor. The design engineer shall coordinate with the geotechnical engineer to conduct the required test borings and analysis to meet the design requirements.

C. Survey adjacent structures and improvements, employing a qualified professional engineer or land surveyor; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Engineer if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that are either new or in serviceable condition.

B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.

C. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.

D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness to meet the requirement of the design.

E. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.

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

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 that could develop during excavation support and protection system operations.

1. Shore, support, and protect utilities encountered.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces is not impeded.

D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.

E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

3.2 SOLDIER BEAMS AND LAGGING

A. Install steel soldier beams before starting excavation. Space soldier beams at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

B. Install wood lagging within flanges of soldier beams as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.

C. Install wales horizontally at centers indicated and secure to soldier beams.

3.3 SHEET PILING

A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Limit vertical offset of adjacent sheet piling to 60 inches. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

A. Tiebacks: Drill for, install, grout, and tension tiebacks into position. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.

1. Test loading shall be observed by a qualified professional engineer responsible for design of excavation support and protection system.
2. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.5 BRACING

A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.

1. Do not place bracing where it will be cast into or included in permanent concrete work, unless otherwise approved by Engineer.
2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.

1. Remove excavation support and protection systems to a depth of below overlying construction and abandon remainder.
2. Repair or replace, as approved by Engineer, adjacent work damaged or displaced by removing excavation support and protection systems.

B. The contractor can leave excavation support and protection systems permanently in place. This must be reviewed and approved by the design engineer responsible for the excavation support and protection.

END OF SECTION 31 50 00

SECTION 316223

CONCRETE FILLED STEEL PIPE PILES

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND REQUIREMENTS

A. Drawings, specifications, and requirements of the contract documents.

1.2 SUMMARY

A. This section includes: providing and installing 14 inch O.D. x 0.375 inch (minimum) wall, closed end, concrete filled steel pipe piles with an allowable compressive axial load capacities of 80 kips (200 kips ultimate capacity). A brief summary of the work is as follows:

1. Mobilization and Demobilization of all equipment and materials for installation of piles.
2. Pile hammer selection based on Wave Equation Analysis for the 80 kip allowable capacity piles (200 kips ultimate capacity).
3. Concrete design mix for 4,000 psi concrete.
4. Pile numbering plan.
5. Production piling, including spudding, jetting, pre-augering or pre-excavation to attain the pile minimum tip elevation if approved by the Geotechnical Engineer of Record. Pay length measured from pile tip elevation to pile cut off elevation.
6. Furnish and place concrete, including dowels and reinforcing embedded in the concrete piles where indicated on contract drawings.
7. Related work shown on the contract drawings and/or defined in these specifications.

1.3 SUBMITTALS

A. The Contractor shall submit the following:

1. Concrete Mix Designs: Submit to the Structural Engineer for review prior to commencement of work.

B. A minimum of one week prior to beginning work, the Contractor shall submit the following drawings or documents showing:

1. Details of piles, pile hammers (including hammer cushion) and installation procedures proposed by the Contractor.
2. Results of the Wave Equations Analysis for a 80 kip allowable capacity pile (200 kips ultimate capacity), and pile driving equipment proposed by the Contractor indicating the pile set (in blows per inch) needed to obtain each capacity.
3. Pile layout for each typical pile cap indicated on the structural drawings.
4. A pile numbering plan for use by the Contractor and Contractor's Geotechnical Engineer for identifying piles.
5. Schedule for installation of piling, indicating the number of pile driving rigs and working hours proposed for pile installation.

6. Pile splice details.

1.4 REFERENCES

A. Except as modified by governing codes and by this specification, the Contractor shall comply with the applicable provisions and recommendations of the latest edition of the following:

1. ACI 301 Specifications for Structural Concrete
2. ACI Recommendation for Design, Manufacture, and Installation of Concrete Piles, ACI 543R.
3. ASTM A252, Standard Specification for Welded and Seamless Steel Pipe Piles.
4. The 2015 International Building Code, New Jersey Edition.
5. ACI 318, "Building Code Requirements for Reinforced Concrete."
6. ACI 304, "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete."
7. AWS D1.1/D1.1M, "Structural Welding Code - Steel".
8. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.5 DESIGN REQUIREMENTS

A. Piles shall be designed and installed, as required by the drawings, to develop a minimum allowable compressive load capacity of 80 kips (200 kips ultimate capacity) for the slab foundations.

B. The piles shall be cast-in-place concrete constructed by the driving of a steel pipe to the required resistance necessary to provide the design pile capacities.

C. Concrete shall be placed in the pipe after it has been approved by the Engineer and shall have a 28-day minimum compressive strength of 4,000 psi. All piles shall have a minimum tip elevation as noted on the plans or in the geotechnical requirements. Pre-excavation methods such as augering or spudding can be used only if approved by the Geotechnical Engineer of Record to attain the required pile tip elevation.

D. Minimum wall thickness of 0.375 inches are suggested for the 80 kips allowable capacity pipe piles, respectively. However, the Contractor shall be responsible for selecting piles with sufficient wall thickness and strength to withstand all handling, driving and installation stresses and to support the design and test loads.

E. At least one (1) “drive test pile” should be installed in the area of the proposed structure to determine the driving characteristics and the required pile lengths more accurately. A wave equation analysis (WEAP) shall be performed and submitted to the Geotechnical Engineer of Record for review prior to the installation of the test pile. PDA and CAPWAP analyses should be carried out during installation of the test pile to determine the required driving criteria for the production piles and to verify that the safe design load capacity is achieved.

1.6 QUALITY ASSURANCE

A. All work performed under this Section shall be performed by a specialty contractor having at least five (5) years of experience in the installation of similar pile foundations.

1.7 PILE DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall handle, transport, and store piles to prevent physical damage. Any materials ordered or delivered to the project site prior to verification of the assumed pile length, will be at the Contractor's risk.

B. After pile lengths have been verified by the Contractor, through the installation of test drive piles, he shall deliver materials to the project site in such quantities and at such times as to assure the continuity of pile driving operations in conformance with the project schedule.

1.8 SUBSURFACE CONDITIONS

The results of a subsurface geotechnical investigation performed on the site are contained in the specification for the Contractor's reference. The contractor may rely on the technical accuracy of the soil boring logs contained in such reports, but not upon nontechnical data, interpretations or opinions contained therein or for the completeness thereof for Contractor's purposes. The Contractor shall have full responsibility with respect to subsurface conditions at the site. As such, the Contractor shall make his own interpretations of the technical data contained in the specifications, and shall perform such additional investigations as he deems necessary to supplement the technical data contained therein. No representation is made that subsurface conditions will not differ between soils borings from those reported at specific boring locations reported upon in the specifications.

1.9 SCHEDULE

A. Submit a schedule for installation of piling, indicating the number of pile-driving rigs and working hours proposed for pile installation.

PART 2 PRODUCTS

2.1 MATERIALS

A. Only new steel piles, ASTM A-252 Grade 3 Modified (50 ksi) steel, shall be used. Minimum pipe pile diameters (O.D.) of 14 inches with a minimum wall thickness of 0.375 inches shall be used for pile capacities (80 kips allowable).

B. Steel for the pipe pile end plates shall be 1 inch thick and have a yield strength of 50 ksi.

C. Reinforcing Steel: ASTM A 615, 60 ksi yield grade, new billet steel, deformed bars.

2.2 CONCRETE MATERIALS

A. Portland Cement: Portland cement shall conform to ASTM C150, Type I or II. Cement shall be freshly manufactured stock of approved brand. Use only the approved brand throughout the project.

B. Fine Aggregate; Fine aggregate shall be clean, natural, siliceous and, consisting of hard, strong, durable, uncoated particles, and shall conform to the requirements of ASTM C33. Dune sand, bank-run sand, and manufactured sand are not acceptable.

C. Coarse Aggregate: Coarse aggregate for stone concrete shall consist of clean, hard, uncoated, strong, durable gravel, or crushed stone, and shall conform to the requirements of ASTM C33.

D. Water: Water for mixing and curing concrete shall be potable and shall not contain amounts of impurities injurious to the concrete.

2.3 ADMIXTURES

A. General: No admixtures shall be used in concrete except with the permission of the Structural Engineer and after laboratory design mix approval.

B. Admixtures shall contain no more chloride ions than are present in municipal drinking water. Certification of conformance to requirements and the chloride ion content will be required from the admixture manufacturer prior to mix design review by the Architect. Upon request only, provide a qualified, full-time representative to assure proper use of admixtures. Use of admixtures other than listed will be permitted only when approved prior to bid.

C. Water-Reducing Admixture: A water-reducing admixture shall be used in all concrete. The admixture shall conform to ASTM C494, Type A, and shall not contain anymore chloride ions than are present in municipal drinking water.

D. Accelerating Admixture: A chloride-free accelerating admixture shall be used in all concrete placed at temperatures below 50 F. The admixture shall conform to ASTM C494, Type F, and shall contain more chloride ions than are present in municipal drinking water.

E. Air-Entraining Admixture: The air-entraining admixture shall conform to ASTM C260 and shall be used where necessary to achieve the specified air content.

F. Water-Reducing Retarder Admixture: A water-reducing retarder admixture shall be used when directed by the Architect.

G. High Range Water Reducing Admixture: Superplasticizer shall be used in all concrete. The admixture shall conform to ASTM C494, Type F, and not contain more chloride ions than are present in municipal drinking water. These admixtures shall be used in strict accordance with manufacturer's recommendations. The high-range water reducing admixture shall be added to the concrete mix at the site through truck-mounted dispensers.

PART 3 EXECUTION

3.1 SURVEY, LINE AND LEVEL

A. The Contractor shall provide a surveyor licensed in the State of New Jersey who shall establish pile locations in each area assigned a pile foundation and be responsible for the correct location of each pile.

B. The Contractor shall provide the necessary instruments and a surveyor licensed in the state of the project to measure pile heave. Elevations shall be taken at the completion of

each pile and at the completion of each pile group, if so directed by the Engineer. Elevation data shall be provided to the Contractor's Geotechnical Engineer prior to moving pile rig from a pile cap location.

C. The Contractor shall provide the Geotechnical Engineer of Record and the Structural Engineer with a survey prepared by his licensed surveyor showing the actual locations of the piles at cut-off elevation. All pile locations shall be referenced to the column centerlines. The pile driving rig shall remain at the site until the completion of the resurvey and a determination has been made as to requirements for additional piles. Pile resurveys shall be presented to the Structural Engineer within 48 hours of the completion of driving of each pile group. At the conclusion of the work, the Contractor shall provide a plan or integrated set of plan indicating the final positions of the piles.

3.2 PILE CUTOFFS

A. Tops of piles shall be cut off level at the elevation shown on the drawings. If the top of the pile is damaged below the cut-off level, it shall be cut off at the level of the undamaged pile and spliced in accordance with the approved splice detail at no additional cost to the Owner.

3.3 PILE TIPS

A. Pipe piles shall be closed at the tip with a 1.0-inch thick steel plate having a diameter equal to the outside diameter of the pipe pile and shall be fully welded to the tip of the pile.

3.4 PILE SPLICES

A. Pile splices shall be welded such as to develop the full compressive and tensile strength of the pile section. Mechanical splices which are not welded shall not be used.

B. Lengths of pile to be spliced shall be secured in proper alignment and in such a manner that no eccentricity between the axis of the two lengths to be spliced, or angle between them results. Splices shall be welded in such a manner, as approved by the Structural Engineer, to form a water-tight joint.

3.5 PILE DRIVING RECORDS

A. The Contractor's Geotechnical Engineer shall keep a separate record of each pile. This record shall give the date of driving, type and size of pile, length, tip and cut-off elevation, splices, pile hammer used, and other relevant information.

B. Driving records for piles shall be submitted to the Geotechnical Engineer of Record on a weekly basis.

3.6 PILE HAMMER

A. Piles shall be driven using single-acting steam, air, or hydraulically powered pile hammers that are capable of driving the piling to the required tip elevation and to the required bearing capacity without damage to the pile. Double-acting hammers and hammers with enclosed rams that preclude observation of the ram drop height shall not be used.

The Contractor shall be responsible for selecting a pile hammer with adequate energy.

The Contractor's pile hammer selection and the driving criterion (in blows per inch) he proposes to use shall be based on the Wave Equation Analysis for the 80 kips allowable capacity piles (200 kips ultimate capacity). The Contractor's calculations, data shall be signed and sealed by a Professional Engineer licensed in the state of the project and shall be submitted to the Engineer for his review and approval.

B. The hammer shall be in good operating condition at all times during driving.

C. Any hammer not operating in accordance with the manufacturer's specifications shall be deemed unsatisfactory and shall be removed from the site.

D. The hammer cushion shall consist of aluminum and micarta or other appropriate material proposed by the Contractor and approved by the Engineer. The use of a hammer cushion consisting of wood chips, small wood blocks, wood shavings, wire rope, or other materials with high elastic properties is unsatisfactory. The hammer cushion used for driving the test drive piles, load test piles and production piles shall be identical to the hammer cushion submitted by the Contractor. New hammer cushion material shall not be installed during the final driving of any piles.

3.7 PILE DRIVE LEADS

A. Piles shall be driven using fixed or swinging leads constructed in such a manner as to afford freedom of movement to the hammer, and such that the pile is held firmly in correct position and in axial alignment with the hammer. Piles shall be accurately positioned and held firmly in position during driving.

3.8 PILE INSTALLATION CRITERIA

A. Production piles shall be installed in the same manner and with the same equipment as the approved test drive and load tested piles of the same size, relative length, and in similar soils shall be driven to the same final penetration resistance as approved by the Geotechnical Engineer or Record. The contractor and/or the contractor’s geotechnical engineer shall provide written guarantee that the piling installed has the required capacity.

B. Driving of all piles shall be continuous from the minimum depth of the bearing strata determined from known subsurface conditions until the driving criterion is met.

C. The Contractor is informed that the site may contain debris and other potential obstructions.

D. In no instance shall jetting be permitted.

E. Drive all vertical piles plumb and in true alignment at the locations shown on plans.

F. Drive piles in such sequence as to prevent distortion or damage to piles previously installed.

G. If directed by the Geotechnical Engineer of Record, record the elevation of each pile top in a pile group and resurvey the elevation of the tops after the other piles in the pile group have been driven. If heaving has occurred at any pile, re-drive all the piles in the group to design capacity at no extra cost to the Owner. The requirement for surveying and resurveying pile top elevations will be waived if it can be demonstrated to the satisfaction of the Engineer that heaving does not occur.

I. After piles have been driven to the required capacity to the satisfaction of the Contractor's Geotechnical Engineer, they shall be neatly cut off in a horizontal plane at the cut-off elevations indicated on the contract drawings. Should be top of the pile be damaged below the cut-off level, cut it off below the damaged section and rebuild it by proper splicing and techniques approved by the Structural Engineer. This work shall be done at the Contractor's expense. Perform no cut-offs until the pile driving is complete the approved for an entire pile cap group. If the Contractor elects to perform pile cutoffs prior to approval, he shall do so at his own risk.

3.9 CONCRETE PROPORTIONS

A. All cast-in-place concrete shall be proportioned by the Contractor in accordance with Specification Section 03300 - Concrete. Proposed mixes shall be submitted for approval.

B. If, during, progress of work, it is found that concrete of required workability and strength cannot be attained with materials furnished, Architect may order changes in proportions or materials, or both, to attain desired properties. Changes so ordered shall be made at Contractor's expense.

C. Cement, aggregate, and other materials required for design or verifications mixes by the laboratory shall be supplied by the Contractor.

D. Measurements of fine and coarse aggregate shall be made separately by weight. The proportioning of aggregate for fractional sacks of cement will not be permitted unless the cement is weighted for each batch. Weighing equipment shall be arranged to permit making compensation for changes in the weight of moisture contained in the aggregate.

E. Minimum compressive strength shall be 4000 psi at 28 days.

F. Maximum slump shall be 3 inches before the addition of the superplasticizer admixture at the site.

G. Air content of concrete shall be 5.0 percent (plus or minus 1.0 percent) of volume of concrete with required strengths maintained.

1. Mixing:

a) All concrete produced for this project shall originate in a plant certified by the National Ready Mix Association, with certification maintained during period of contract work.
b) Mix in ready mixing equipment conforming to ASTM C-9. Do not exceed manufacturer's rated capacity of mixer.
c) Ready-mixed concrete shall be mixed and delivered as specified for transit-mixed concrete in ASTM C94.

3.10 CONCRETING

A Piles shall not be filled with concrete until the pipe pile has been inspected and approved by the Owner's representative as suitable for placement of concrete. Any piles containing water shall be bailed dry until approved by the Geotechnical Engineer. Concrete shall be placed by a method such that segregation of the concrete does not occur. Concrete shall be placed by such methods that will insure the entire volume of the pile is filled without interruption.

3.11 TOLERANCES

A. Piles shall be accurately located and their location at cutoff shall not vary by more than three (3) inches from plan locations for the pile cap.

1. For single slab piles, location tolerance may be increased to six (6) inches from plan locations.

B. No piles are to be driven more than three (3) percent out of plumb.

3.12 NON-CONFORMING PILES

A. Any pile damaged during driving, driven outside the specified tolerance for position, driven more than three percent out of plumb, abandoned due to obstructions, or otherwise not conforming with the Contract requirements shall be abandoned. Abandoned piles shall be filled with concrete and cut off one foot below the bottom of pile caps. The Contractor shall replace the abandoned pile with an additional pile or piles at no additional cost to the Owner.

B. If any pile driven to the specified resistance in the specified stratum is found to be out of plumb more than three percent of its length or if its center at the cut-off elevation is out of position such a distance that any pile is loaded more than 110 percent of its design load or as to change the shape of the pile group, making it necessary to investigate and/or redesign the pile caps or other foundation concrete, the Contractor shall provide and install additional piles as directed and make such changes in pile caps, as required, so that no pile in the completed group shall be loaded more than 110 percent of its designed position. The cost of additional piles and/or changes to concrete pile caps or other foundation members, as well as the associated redesign costs made for this purpose, shall be borne by the Contractor.

C. Work of whatever nature required on account of rejected, damaged, or displaced piles shall be provided by the Contractor as required and without additional cost to the Owner.

D. All redesign, analysis, investigation, review and any other related work by the Structural Engineer or the Geotechnical Engineer of Record necessitated by the Contractor's proposals, or work, or failure to perform as specified, the cost of which is specified herein as the Contractor's responsibility, shall be paid to the Structural Engineer and the Geotechnical Engineer of Record at the rate of 2.5 times direct personnel expense for all personnel, plus computer costs and any other incurred expenses, within 30 days after receipt of the Engineer's invoice for such services.

3.13 FIELD QUALITY CONTROL

A. The Geotechnical Engineer shall be engaged by the Contractor to verify that piles are installed in accordance with design and code requirements, to maintain driving records, and to confirm pile driving criteria in the field.

B. A record shall be kept by the Contractor's Geotechnical Engineer of the total penetration of every pile and the behavior of the pile during driving. Summary records kept by the Geotechnical Engineer for each pile shall include:

1. Date and time when driven.
2. Pile length, tip elevation, and cut-off elevation.
3. Type, weight, and stroke of hammer.
4. Final penetration resistance.
5. Pile heave and re-drive measurements, as applicable.
6. Pile splices.

C. Any check borings required by the Contractor shall be paid for by the Contractor.

D. The pile driving summaries, sealed by a licensed professional engineer, shall be provided by the Contractor's Geotechnical Engineer to the Owner and the Geotechnical Engineer or Record for filing with the appropriate agency.

E. Provide free access to work and cooperate with appointed firm.

END OF SECTION 316223

SECTION 323113
PVC COATED CHAIN LINK FENCE AND SWING GATES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Poly Vinyl Chloride (PVC) coated chain link fabric with PVC color coated galvanized steel framework and accessories for commercial or industrial applications.

1.02 RELATED SECTIONS

01300 Submittals

1.03 REFERENCES [delete references not applicable to project]

A. ASTM A36 Standard Specification for Carbon Structural Steel

B. ASTM F552 Standard Terminology Relating to Chain Link Fencing

C. ASTM F567 Standard Practice for Installation of Chain Link Fence

D. ASTM F626 Standard Specification for Fence Fittings

E. ASTM F668 Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain Link Fence Fabric

F. ASTM F900 Standard Specification for Industrial and Commercial Swing Gates

G. ASTM F934 Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials

H. ASTM F1043 Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework

I. ASTM F1083 Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures

J. WLG2445 Chain Link Fence Manufacturers Institute, Chain Link Fence Wind Load Guide for the Selection of Line Posts and Line Post Spacing

K. ASTM F969 Standard Practice for Construction of Chain-Link Tennis Court Fence

1.04 SUBMITTALS

A. Shop drawings: Layout of fences and gates with dimensions, details, and finishes of components, accessories, and post foundations.

B. Product data: Manufacturer’s catalog cuts indicating material compliance and specified options.

C. Samples: If requested, samples of materials (e.g., fabric, wires, color, and accessories).

1.05 QUALITY ASSURANCE

A. Manufacturer: Company having manufacturing facilities in the United States with 5 years experience specializing in manufacturing of chain link fence products.

B. Contractor: Contractor having 5 years experience installing similar projects in accordance with ASTM F567.

C. Tolerances: ASTM current specification and tolerances apply and supersede any conflicting tolerance.

D. Single source: To ensure system integrity obtain the chain link system, framework, fabric, fittings, gates and accessories from a single source.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Approved Manufacturer: Master Halco, Inc.
One City Blvd. West, Suite 900
Orange, CA 92868
Phone (800) 229-5615 Fax (714) 385-0107
www.masterhalco.com, E-mail: spec@fenceonline.com

B. or approved equal.

2.02 CHAIN LINK FENCE FABRIC

A. Poly Vinyl Chloride (PVC) color coated steel chain link fabric per ASTM F668 Class 2b

B. Size and Height: Chain link fabric 2 in. mesh, 11 gauge, 0.120 in. diameter steel core wire having a break load of 850 lbf, height, 72 in.

C. Selvage of fabric knuckled at top and knuckled at bottom.

D. Color of chain link fabric per ASTM F934 -Black.

2.03 PVC COLOR COATED STEEL FENCE FRAMEWORK - Black.

A. Steel pipe Type I: ASTM F1043 Group IA, ASTM F1083 standard weight schedule 40 hot-dip galvanized pipe having a zinc coating of 1.8 oz/ft² (550 g/m²) on the outside and 1.8 oz/ft² (550 g/m²) on the inside surface. Exterior of pipe to have F1043 PVC thermally fused color coating, minimum thickness 10 mils (0.254 mm).

Regular Strength Grade: Minimum steel yield strength of 30,000 psi.

B. Pipe End and Corner Post: 2.375" OD, 3.65 lbs/ft.

C. Pipe Line Post: 2.375" OD, 3.65 lbs/ft.

D. Pipe Rail and Braces, 1.660 in. OD, 2.27 lbs/ft.

E. Gate Posts: 2.875 in. OD for single gate; 6.625 in. OD for double gate.

2.04 FITTINGS

A. All fittings to be PVC thermally fused color coated having a minimum thickness of 0.006” (0.152 mm) per ASTM F626. PVC color to match fabric and framework. Moveable parts, nuts and bolts to be field coated with PVC liquid touch up after installation.

B. Post caps: ASTM F626 galvanized pressed steel, malleable iron, or aluminum alloy weather tight closure cap for tubular posts. Provide one cap for each post. Provide line post loop caps to secure top rail.

C. Rail ends: Galvanized pressed steel per ASTM F626, for connection of rails to post using a brace band.

D. Top rail sleeves: 7” (178 mm) galvanized steel sleeve per ASTM F626.

E. Wire ties: 9 gauge (0.148”) (3.76 mm) galvanized steel wire for attachment of fabric to line posts and rails. Tie wire PVC coated and in compliance with ASTM F626. Color to match fabric color.

F. Brace and tension (stretcher bar) bands: ASTM F626 galvanized 12 gauge (0.105”) (2.67mm) pressed steel by 3/4” (19mm) formed to a minimum 300 degree profile curvature for post attachment. Secure bands using minimum 5/16” (7.94 mm) galvanized carriage bolt and nut.

G. Tension (stretcher) galvanized steel bars: One piece lengths equal to 2 inches (50 mm) less than full height of fabric with a minimum cross-section of 3/16” x 3/4” (4.76 mm x 19 mm) per ASTM F626. Provide tension (stretcher) bars where chain link fabric is secured to the terminal post.

H. Truss rod assembly: Galvanized steel minimum 5/16” (7.9mm) diameter truss rod with pressed steel tightener, in accordance with ASTM F626

I. Carriage bolts and nuts: Galvanized of commercial quality

2.05 CHAIN LINK SWING GATES

A. Swing gates - double leaf 24' opening by 6' high, single leaf - 4' opening by 6' high. Fabricate chain link swing gates in accordance with ASTM F900. Gate frame to be of welded construction. Weld areas to be protected with zinc-rich paint per ASTM A780 then over coated with liquid PVC to match frame. The gate frame members are to be spaced no greater than 8’ 0” (2.44 m) apart horizontally or vertically. Exterior members to be 1.900” (48.3 mm) OD pipe, interior members when required shall be 1.660” (42.2 mm) OD pipe. PVC coated pipe to be Grade 1 ASTM F1083 per section 2.03. Chain link fabric to match specification of fence system. Fabric to be stretched tightly and secured to vertical outer frame members using tension bar and tension bands spaced 12” (304.8 mm) on center and tied to the horizontal and interior members 12” (304.8 mm) on center using 9 gauge galvanized steel ties per section 2.04.

B. Hinges, hot dip galvanized pressed steel or malleable iron, structurally capable of supporting gate leaf and allow opening and closing without binding. Non-lift-off type hinge design shall permit gate to swing 180° (3.14 rad)

C. Latch: Galvanized forked type capable of retaining gate in closed position and have provision for padlock. Latch shall permit operation from either side of gate. Provide accessible latch where shown on plans.

D. Double gates: Provide galvanized drop rod with center gate stop pipe or receiver to secure inactive leaf in the closed position. Provide galvanized pressed steel locking latch, requiring one padlock for locking both gate leaves, accessible from either side.

E. Keeper to secure open leafs: Provide galvanized gate hold back keeper for each gate leaf over 5’ (1524 mm) wide. Gate keeper shall consist of mechanical device for securing free end of gate when in full open position.

F. Latch, hinges, moveable parts may be field coated with liquid PVC.

G. Gate posts: PVC color coated Grade 1 pipe ASTM F1083 in accordance with section 2.03,

H. Swivel Wheels: Provide swivel wheels for swing gates in accordance with manufacturer’s written recommendations and instructions

2.06 POST SETTING MATERIALS

A. Concrete: N.J.D.O.T. Class "B" Concrete.

PART 3 EXECUTION

3.01 SITE EXAMINATION

A. Ensure property lines and legal boundaries of work are clearly established.

B. Survey of fence location to be provided by contractor

C. Verify areas to receive fencing are completed to final grade.

3.02 CHAIN LINK FRAMEWORK INSTALLATION

A. Install chain link fence system in accordance with ASTM F567 and manufacturer’s instructions.

B. Locate terminal post at each fence termination and change in horizontal or vertical direction of 30° or more.

C. Space line posts uniformly at a maximum of 10’ (3048 mm) on center.

D. Concrete set posts: Dig holes in firm, undisturbed or compacted soil. Place concrete around posts in a continuous pour. Trowel finish around post and slope to direct water away from posts.

E. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.

F. Bracing: Install horizontal brace and truss assembly at mid-height or above for fences 6’ (1829 mm) and over at each fabric connection to the terminal post. The diagonal truss rod is installed at the point where the brace rail is attached to the terminal post and diagonally down to the bottom of the adjacent line post. Place the truss rod in tension by adjusting the turnbuckle.

G. Top rail: Install in lengths of 21’ (6.400 m). Connect ends with sleeves forming a rigid connection, allow for expansion and contraction.

H. Bottom Rails: Install bottom rails between posts and attach to post using rail end or line rail clamps.

I. Touch up any nicks or scratches of the PVC color coating with liquid PVC paint.

3.03 CHAIN LINK FABRIC INSTALLATION

A. Fabric: Install fabric on inside of the court play area, pull fabric taut; thread the tension bar through fabric and attach to terminal posts with tension bands spaced maximum of 15" (381 mm) on center and attach so that fabric remains in tension after pulling force is released. Install fabric so that it is 1" (25 mm) above finish grade.

B. Secure fabric using wire ties to line posts at 15" (381 mm) on center and to rails and braces 24" (610 mm) on center, and to the tension wire using hog rings 24" (610 mm) on center. Tie wire shall be secured to the fabric by wrapping it two 360 degree turns around the chain link wire pickets. Cut off any excess wire and bend back so as not to protrude so as to avoid injury if a pedestrian may come in contact with the fence.

3.04 CHAIN LINK GATE INSTALLATION

A. Swing gates: Installation of swing gates and gate posts shall be per ASTM F567. Direction of swing shall be as shown on drawings. Gates shall be hung plumb in the closed position with minimal space from grade to bottom of gate leaf. Double gate drop bar receiver shall be set in a minimum concrete footing 6" (152 mm) diameter by 24" (610 mm) deep. Gate leaf holdbacks shall be installed on all double gates and all gate leafs greater than 5' (1524 mm) in width.

3.05 ELECTRICAL GROUNDING

A. Grounding shall be performed by a licensed electrical contractor.

3.06 SITE CLEAN UP

A. Clean up area adjacent to fence line from debris and unused material created by fence installation.

END OF SECTION

SECTION 328400

AUTOMATIC IRRIGATION SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. The work required under this Section consists of furnishing all system design, labor, materials, equipment, services, and related items necessary to complete all IRRIGATION SYSTEM installation and all related work complete, which will efficiently irrigate all areas of new plantings which are part of the project.

B. Major items of work include, but are not limited to, the following:

1. Shop drawings for design of a fully operational, automatically controlled irrigation system, must be designed by a certified irrigation designer.
2. Trenching and backfill.
3. Proper backflow protection according to local codes, ordinances, and permits.
4. Test all systems and make operative.
5. "As-built" drawings.

1.02 RELATED SECTIONS

1. Excavation and Backfill
2. Electrical General Requirements - Division 16

1.03 QUALITY ASSURANCE

A. Permits and Fees

Obtain all permits and pay required fees to any governmental agency having jurisdiction over the work. Inspections required by local ordinances during the course of construction shall be arranged as required. On completion of the work, satisfactory evidence shall be furnished by the Irrigation Contractor to show that all work has been installed in accordance with the ordinances and code requirements. All fees shall be the responsibility of the contractor and should be included in the base bid.

B. Equipment Manufacturer

1. Supply all automatic irrigation equipment specified below, new and in perfect condition, and by a single manufacturer, unless otherwise specified.

2. The manufacturer (equipment supplier) must currently be in the business of supplying irrigation equipment for not less than ten (10) years and shall have previously supplied irrigation equipment for at least ten (10) successful projects of similar size and complexity.

C. Installer

A firm must demonstrate their experience in the execution of irrigation systems similar to the size, scope, and complexity of this project as shown and specified and who can demonstrate said experience through documented references or be duly certified by the State of New Jersey.

1.04 SUBMITTALS

A. Product Data: Submit six (6) copies of and/or samples for all materials and items, as required by the Engineer.

B. Manuals: Submit six (6) copies of operation and maintenance manuals.

C. Materials submitted shall include, but are not limited to, the following:

Valves	Pipe (including drip line)
Valve Boxes	Controller (including remote)
Spray Heads	Fittings
Rain Sensor	Swing Joint

D. Shop drawings of system design/layout: Submit CAD or pdf drawings to scale to the Project Consultant for review and approval.

E. All product data, manuals, and materials shall be submitted together with the shop drawings for review and approval.

1.05 APPROVAL

Wherever the terms “approve”, “approval”, or “approved” are used in the specifications, they shall mean the approval of the Owner or Project Consultant in writing.

1.06 COORDNATION

A. Coordinate and cooperate with other contractors to enable the work to proceed as rapidly and efficiently as possible.

1.07 EXISTING SITE CONDITIONS

A. The Contractor shall take necessary precautions to protect existing site conditions. Should damage be incurred, the Contractor shall repair the damage to it’s original condition at his own expense.

B. Contractor shall acquaint himself with all site conditions. Should utilities not shown on the plans be found during excavations, Contractor shall reroute system as necessary to avoid utilities.

C. Utility stakeout shall be the responsibility of the contractor. Any cost incurred shall be included in the bid.

D.

1.08 SUBSTITION AND REJECTION

The Project Consultant reserves the right to reject material or work which does not conform to the Contract Documents. Rejected work shall be removed or corrected at the earliest possible time.

1.09 PIPING ARRANGEMENT

Suggestions for changes in location of piping, etc., advisable in the opinion of Contractor, shall be submitted to the Owner for approval before proceeding with the work, with written assurance that such changes will not cause any extra cost on their part or alteration of design requirements.

1.10 PROTECTION

A. Contractor shall be responsible for work until finally inspected, tested, and accepted. After delivery and before and after installation, protect work against theft, injury, or damage. Protect open ends of work with temporary covers or plugs during construction, to prevent entry of obstructing material.

B. Protect work, equipment, and material of all other trades from damage that might be caused by this work or workmen and shall pay for all such damage, should it occur.

1.11 GROUNDING OF SYSTEM

Ground controllers to building grounding system and/or according to manufacturer's specifications and recommendations.

PART 2 - MATERIALS

2.01 GENERAL

A. All materials throughout the system shall be new and in perfect condition. After award of the Contract, and prior to beginning the work, the Contractor shall submit for approval two copies of the complete list of materials which he proposes to install. Quantities of materials and equipment need not be included. No deviations from the specifications shall be allowed.

2.02 PLASTIC PIPING

A. All main line pipe 3" and smaller shall be Class 200: Type 1120-1220 polyvinyl chloride (PVC) pipe and shall conform to U.S. Department of Commerce Commercial Standard (CS-256-63).

B. Smaller systems requiring less than 40 PSI working pressure with less than 35 GPM demand may use a 100 lb. Polyethylene pipe for unpressurized laterals. Consult Engineer if poly pipe is bid for laterals. Polyethylene pipe shall **never** be considered for main line or pressurized laterals.

2.03 PLASTIC FITTINGS

A. Schedule 40, polyvinyl chloride (PVC) standard weight as manufactured by Sloan, Lasco, or approved equal.

B. Only solvent weld or insert fittings are acceptable; no saddle type clamping of fittings will be used.

C. If poly pipe is used for laterals, only PVC insert type fittings and 100% stainless steel clamps are acceptable.

2.04 SOLVENT CEMENT

Compatible with PVC pipe and of proper consistency.

2.05 SELF-CLEANING, PRESSURE-COMPENSATING DRIP LINE

A. Drip lines shall consist of one half inch low density linear polyethylene tubing, housing internal, pressure compensating, self-cleaning, integral drip emitters. The tubing shall be brown in color and conform to an outside diameter (O.D.) of .67 inches and an inside diameter (O.D.) of .57 inches.

1. Emitters shall have the ability to independently regulate discharge rates, with an input pressure of seven to seventy pounds per square inch (PSI), at a constant flow and with a coefficient of volume (CV) of .03. The emitter discharge rate shall be either .61 gallons per hour (GPH) or .92 gallons per hour (GPH) utilizing a combination turbulent flow/reduced pressure compensation cell mechanism and a diaphragm to maintain uniform discharge rates.

2. Emitters shall continuously clean themselves while in operation and shall be color coded to indicate their discharge rate: Red to indicate .61 GPH emitters and black to indicate the .92 GPH emitters. The colors shall be visible through the outlet orifice of each emitter.

3. Drip line shall be available in 12 inch, 18 inch, 24 inch, and 36 inch spacing between emitters.

2.06 FITTINGS

Drip line connections shall be made with compatible 17 m (.57”) insert fittings.

2.07 ACCESSORIES

A. Automatic Line Flush Valves shall be utilized at the end of each independent zone area or drip line. Valve shall be capable of flushing one gallon at the beginning of each irrigation cycle.

B. Each independent irrigation zone shall utilize an Air/Vacuum Relief Valve at its high points for the purpose of relieving air pockets at cycle start up or vacuum at system shut down.

2.08 PRESSURE REGULATION VALVE

The pressure regulator shall be a piston type unit with an externally accessible regulation unit that can be serviced without removing the valve from the system. The regulator shall have a built in indicator that shows when the proper outlet pressure is reached. It shall be able to respond immediately to any inlet pressure variation and capable of regulating from 15 PSI to 50 PSI using interchangeable color coded springs.

2.09 DISC FILTER

The filter shall be a disc filter (or equal) design with color coded filter elements indicating the mesh size of the element being used. The discs shall be constructed of chemical resistant thermoplastic for corrosion resistance.

2.10 SPRINKLER HEAD RISERS

Schedule 80 PVC for risers. Clean all rough edges or burrs. Spears triple swing joint construction throughout.

2.11 MANUAL VALVES

Valves shall be at each zone, and shall be made of brass or bronze of the ball type closure.

2.12 ELECTRIC REMOTE CONTROL VALVES

Electrically operated solenoid valves installed in valve boxes of appropriate size with manual shut off valve to match pipe size.

2.13 CONROL EQUIPMENT-ELECTRO MECHANICAL

Each controller location shall be easily accessible for maintenance. It shall be possible to make minor timing adjustments to the controller in the field. There shall be no time lag between sections of stations and the controller will be of a compatible type for operating the automatic control valve. If the timing mechanism of the controller has to be removed from the field for service, the controller shall be capable of continued manual operation, with an A or B Program Switch.

2.14 EXPANSION CURLS

Expansion curls shall be provided within 3 feet of each wire connection to a solenoid and at least every 300 feet in length. (Expansion curls are easily formed by wrapping at least 5 turns of wire around a rod or pipe 1” or more in diameter, then withdrawing rod.)

2.15 VALVE BOXES

Valve boxes with underground sectionalizing shall, unless otherwise detailed on Plan, consist of a 12” standard box as manufactured by Ametek, or approved equal. All valve boxes in roadways or sidewalks shall be cast iron construction with lock lid.

2.16 COMMUNICATION CIRCUITRY

Electric control lines (24 volt) from each controller to the automatic valves shall be direct burial UF wire of a different color than the black and white wires used on the 115 volt AC power. All wire shall be furnished in minimum 2,500' reels and spliced only at valve or tee locations. Wire sizing shall be as specified on the contractor's submittal drawings drawings.

2.17 CONTROL WIRES

24 volt solid wire UL approved for direct burial in ground. Minimum wire size: 14 gauge.

2.18 SLEEVES FOR CONTROL WIRES

Provide PVC 1220-160 PSI, plastic pipe or galvanized heavy wall steel conduit, under all walks and paving and where indicated on drawings for control wires.

2.19 SLEEVES FOR IRRIGATION PIPE

A. Under all walks and paving and where indicated on drawings for irrigation pipe. Provide Schedule 80 PVC plastic pipe or as otherwise approved by Engineer.

2.20 SPRINKLER HEADS

A. All full and part circle sprinklers shall be of the fixed spray or gear driven variety. Sprinklers shall be of the pop-up type with spring retraction. The body of the sprinkler shall be constructed of Cycolac Material and be easily serviced from the top. It shall have an accessible screening device and shall perform to the manufacturer's specifications with regard to the diameter of throw and gallonage at a given pressure. All spray heads shall have a pressure compensation device on nozzles.

B. Spacing of heads shall not exceed the manufacturer's maximum recommendation.

2.21 DRAINS

Air hose connections of approved design shall be provided for winterizing at several locations so that the entire system can be drained by blowing it out with compressed air.

2.22 REDUCED FLOW BACKFLOW PREVENTION UNITS

In compliance with local codes.

2.23 QUICK COUPLING VALVES

Shall be noted on drawings submitted.

2.24 RAIN SENSOR

An approved mechanical device shall be installed to prevent irrigation cycling during periods of rainfall.

2.25 RUBBER HOSE

One (1) heavy duty, reinforced rubber hose, 50 feet length shall be provided by the Contractor to the Owner for use with Quick Coupling Valves.

PART 3 - EXECUTION

3.01 SHOP DRAWINGS

Indicate upon the plan the various types and locations of the water emitting devices, the lines/laterals/sleeves, the valve boxes, the separate watering zones, the water source(s), and the controller(s). Provide an equipment schedule that indicates the manufacturer's various produce model numbers proposed for installation.

3.02 PREPARATION

Coordination: Advise installers of other work about specific requirements relating their placement of piping and electrical work which are to be used in this system. Furnish installers of other work with drawings showing location of such equipment.

3.03 WORKMANSHIP

A. Accuracy

Lay out work as accurately as possible to the drawings. The drawings, though carefully drawn, are generally diagrammatic to the extent that swing joints, offsets, and all fittings are not shown.

B. Coverage

The Contractor shall be responsible for full and complete coverage of all irrigated areas and shall make any necessary minor adjustments at no additional cost to the Owner. If not specified on the plans, the Contractor shall be responsible for proper nozzle choice and arc adjustment to assure:

1. Matched precipitation of all heads within each area and zone.
2. Proper flow rates not to exceed 7 feet/second in any piping.

C. Revisions

Any major revisions to the irrigation system must be submitted and answered in written form, along with any negotiated change in contract price.

3.04 INSTALLATION

A. Excavating and Trenching

1. Restore all surfaces, existing underground installations, etc., damaged or cut as a result of the excavations to their original condition and in a manner approved by the Project Consultant.

2. Trenches shall be made wide enough to allow a minimum of 2 inches between parallel pipe lines. Trenches or pipe lines shall be made of sufficient depths to provide minimum cover from finish grade as follows:

   a. 18” minimum cover over main lines.
   b. 12” minimum cover over control wires from controller to valves.
   c. 12” minimum cover over lateral lines to leads.
   d. 24” minimum cover under all paved walks and roads.

3. Maintain all warning signs, shoring barricades, flares, and red lanterns as required by the Safety Orders of the division of Industrial Safety and any local ordinances.

B. Pipe Line Assembly

1. Install remote control valves where shown and group together where practical. Place no closer than 6 inches to walk edges, buildings, and walls.

2. Plastic pipe and fittings shall be solvent welded using solvents and methods as recommended by manufacturer of the pipe, except where screwed connections are required. Pipe and fittings shall be thoroughly cleaned of dirt, dust, and moisture before applying solvent with a non-synthetic bristle brush.

3. Pipe may be assembled and welded on the surface. Snake pipe from side to side of trench bottom to allow for expansion and contraction.

4. Make all connections between plastic pipe and metal valves or steel pipe with threaded fittings using plastic male adapters.

C. Sprinkler Heads

Install all sprinklers as detailed on contractor’s submittal drawings or specifications. Use only Teflon tape on all threaded connectors.

D. Closing Pipe and Flushing Lines

1. Cap or plug all openings as lines have been installed to prevent the entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation.

2. Thoroughly flush out all water lines before installing heads, valves, and other hydrants.

3. Test in accordance with specified procedures for Hydrostatic Tests.

4. Upon completion of the testing, the Contractor shall complete assembly and adjust sprinkler heads for proper distribution.

E. Hydrostatic Tests

1. Request the presence of the Owner or Project Consultant in writing at least 48 hours in advance of testing.

2. Testing to be accomplished at the expense of the Contractor and in the presence of the Owner or Project Consultant.

3. Center load piping with small amount of backfill to prevent arching or slipping under pressure.

4. Apply a continuous and static water pressure of 60 PSI when welded plastic joints have cured at least 24 hours and with the risers capped as follows:

   a. Main lines and sub-mains to be tested for 1 hour.

   b. Lateral lines to be tested for 1 hour. (If laterals and individual sub-mains downstream of control valves have less than 90 PSI working pressure or less than 10 GPM flow, hydrostatic tests are waived for these laterals.)

5. Repair leaks resulting from tests.

F. Automatic Controllers

Connect remote control valves to controller in a logical sequence acceptable to the Owner or the Engineer.

G. Automatic Control Wiring

1. Install control wires, sprinkler mains, and laterals in common trenches wherever possible.

2. Install control wires at least 18 inches below finish grade and lay to the side and below main line. Provide looped slack at valves and snake wires in trench to allow for contraction of wires. Tie wires in bundles at ten foot intervals.

3. Control wire splices will be allowed only in runs more than 500 feet. Any splices must be installed in separate valve boxes installed flush with finished grade.

4. All wire passing under existing or future paving, construction, etc., shall be encased in plastic or galvanized steel conduit extending at least 12 inches beyond edges of paving or construction.

5. Make connections to the site electrical system as is required for the proper operation of the automatic control system.

H. Backfill and Compacting

1. After system is operating and required tests and inspections have been made, backfill excavations and trenches with clean soil, free of rubbish.

2. Backfill for all trenches, regardless of the type of pipe covered, shall be compacted to minimum 90% density.

3. Compact trenches in areas to be planted by thoroughly flooding the backfill.

4. Dress off all areas to finish grades.

3.05 COOPERATION AND CLEAN-UP

Cooperate fully with the other Contractors on the job site in a clean and safe condition. At the end of each days work, store all of tools, equipment, and materials and clean debris from the job. Upon the completion of the job, immediately remove all tools, equipment, and any surplus materials and all debris caused by this work.

3.06 "AS-BUILT" DRAWINGS

Prepare an "As-Built" drawing on a reproducible mylar which shall show deviations from the submittal documents made during construction affecting the main line pipe, controller locations, remote control valves, quick-coupling valves, and all sprinkler heads. The drawing shall also indicate and show approved substitutions of size, material, and manufacturer's name and catalog name and catalog number. The drawings shall be delivered to the Engineer before final acceptance of work.

3.07 FINAL ACCEPTANCE

Final acceptance of the work shall be obtained from the Owner upon the satisfactory completion of all the work and training by the Contractor of key individuals associated with the maintenance and/or management of the finished system.

3.08 GUARANTEE

A. Guarantee all work for two years from date of acceptance against all defects in material, equipment, and workmanship. Guarantee shall cover repair of damage to any part of the premises resulting from leaks or other defects in material, equipment, and workmanship to the satisfaction of the Owner. Repairs, if required, shall be done promptly at no cost to the Owner.

B. Guarantee will include spring start-up and winterizing of system within the one (1) year time and development of approved water application. Winter damage due to improper winterization is the responsibility of the Contractor.

C. All repairs and servicing required under the guarantee period shall be made under the observation of the Owner's maintenance crew to help train them for the proper operation of the system.

TECHNICAL SUBMITTAL REQUIREMENTS

Item	Submittal	Category		
		For Approval	**For Information**	**Sample**
1	Manufacturer's product data	X		
2	Manufacturer's manuals/catalogue cuts	X		
3	Shop drawings for system design	X		
4	System water consumption estimate		X	
5	Suggested changes to system	X		

END OF SECTION

SECTION 330519

DUCTILE IRON CULVERT PIPE

SECTION 1- GENERAL

A. DESCRIPTION

1. Furnish and install Ductile Iron Gravity Storm Sewer Piping for proposed storm sewer system complete as shown on the drawings and specified herein.

B. SUBMITTALS

1. Contractor shall supply eight (8) paper copies or one (1) electronic copy of shop drawings for all pipe and fittings for approval prior to installation.

2. Submit eight (8) copies of manufacturer's certified letter stating that the pipe or joint materials ordered meets the requirements of this specification. Letter shall indicate compliance with appropriate reference standards listed.

C. QUALITY ASSURANCE

1. Testing of Pipe - All Ductile Iron Pipe shall be tested by the manufacturer in accordance with ANSI A21.51 and shall have Underwriters Laboratory approval. Manufacturer shall validate other than certification, the ductility of each length of pipe by an Underwriters Laboratory approved method.

SECTION 2 - MATERIALS

A. Ductile Iron Pipe and Fittings - Below Grade

1. Pipe shall be bitumastic lined Class 52 as specified on plans, Ductile Iron Pipe with push on joints conforming to AWWA C151.

B. Bitumastic lining for pipe and fittings shall conform to AWWA C104.

C. Specials

1. Pipe Adapters : Where necessary to join pipe of different types, Contractor shall provide necessary adapters. Ends shall conform to the specifications for the appropriate type of joint.

D. Identification: All pipeline materials shall be stamped, marked or identified with the following:

1. Name of Manufacturer
2. Pipe Size
3. Pipe Material
4. Wall Thickness
5. Pipe Rating

SECTION 3 - EXECUTION

A. General - All ductile iron pipe shall be installed in accordance with the details shown on the drawings unless otherwise hereinafter specified and all excavation and backfill shall conform to the requirements herein specified.

B. Handling Ductile Iron Pipe & Accessories - All ductile iron pipe and accessories shall be new material which has at no time previously been used for any purpose whatsoever. Pipe and accessories shall be handled in such a manner to insure delivery on the work in sound, undamaged condition and conforming in all respects to these specifications. Particular care shall be taken not to injure the pipe coating. No other pipe or material of any kind shall be placed inside of any pipe or fittings at any time after the coating has been applied.

C. Placing Pipe in Trench - The interior of all pipe shall be thoroughly cleaned of all foreign matter before being lowered into the trench and shall be kept clean during laying operations by means of plugs or other approved methods. No trench water shall be allowed to enter the pipe or fittings. At all times when work is not in progress, all open ends of pipes and fittings shall be securely closed to the satisfaction of the Engineer.

D. Laying Pipe - The spigot shall be centered in the bell, the pipe centered home and brought into true and specified alignment.

Except where necessary in making connection with other lines and as authorized by the Engineer, pipe shall be laid with the bells facing in the direction of laying, and for lines on the appreciable slope bells shall, at the direction of the Engineer, face upgrade.

Under no circumstances will pipe be laid in water and no pipe shall be laid when trench conditions or the weather is unsuitable for such work, except by permission of the Engineer.

E. Cutting Pipe - Cutting the pipe for closure pieces or for other reasons shall be by a method which will not damage the pipe lining . Unless otherwise authorized by the Engineer, all cutting of pipes shall be done by means of mechanical cutters of an approved type or types. Wheel cutters shall be used wherever practicable.

F. Pipe Supports - All exposed piping shall be provided with a minimum of two supports per full pipe length.

END OF SECTION

SECTION 330531.12

POLYVINYL CHLORIDE GRAVITY SEWER HOUSE CONNECTIONS

SECTION 1 – GENERAL

1.01 DESCRIPTION

House connections shall include the excavation and backfill for and the construction of house connections for the conveying of sanitary sewage in accordance with the plans and specifications.

SECTION 2 – MATERIALS

2.01 MATERIALS

A. Poly Vinyl Chloride Pipe shall conform to ASTM D-3034, Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings, SDR 35; Size 6” or SDR 26, 6".

B. Joint Material: Elastomeric ring rubber gasket, ASTM D-3212.

C. Joint Material Primer/Adhesive: As provided or specified by pipe manufacturer.

D. Cleanout shall be 4” cast iron ferrule with 3½” IDS tapping brass screw plug.

SECTION 3 – EXEUCTION

3.01 METHOD OF CONSTRUCTION

A. Excavation and backfill shall be as specified heretofore in the Specifications.

B. Pipe laying, joints, infiltration limits shall be as required for sanitary sewers.

C. Wherever so directed by the Engineer, the Contractor shall construct house connections as designated by the Engineer. House connections shall be in general a 4” PVC pipe constructed at locations designated by the Engineer, laid from main to a point two feet behind the curbline or as necessary to connect to the existing lateral as shown on the plans at a minimum slope of 1/8“ per foot. House connections shall be connected to the tee or wye branch of the sewer main of the proposed or existing main as indicated on the plans.

END OF SECTION

SECTION 330531.16

PVC WATER DISTRIBUTION MAIN

SECTION 1 – GENERAL

1.01 DESCRIPTION

The installation of PVC pressure pipe for proposed potable water distribution system.

SECTION 2 – MATERIALS

2.01 MATERIALS

A. Materials for pipe shall meet the following requirements:

1. PVC Compound: Class 12454 conforming to ASTM D1784.

2. Pipe: ASTM D2241

   a. Coupling shall be an integral part of pipe.

   b. Pipe shall have slip-on joints with a rubber sealing ring.

   c. Pipe and couplings shall meet the requirements of AWWA C900 standards for conveying potable water under pressure.

   d. Pipe shall be PVC "Blue Brute" as manufactured by JM Eagle or approved equal.

   e. Pressure rating shall be 150 psi with Dimension Ratio (DR) of 18.

   f. Pipe shall have cast iron equivalent outside diameter (O.D.).

3. Rubber Rings: ASTM F477.

4. Rubber rings and lubricants shall be made from materials that are compatible with the PVC plastic material and with each other when used together, will not support the growth of bacteria and will not adversely affect the potable qualities of the water to be transported. Lubricants shall be supplied by the pipe manufacturer.

5. Joint Restraining Devices: Restraining joints shall be placed at all bends, tees, plugs, reducers, and other fittings to provide lateral support.

   a. Joint restraint devices for C-900 PVC pipe used with ductile iron mechanical joint fittings shall be EBAA Iron Sales, Inc., Series 2000 PV, Uni-Flange 1300, Star Pipe Product, L.P., or approved equal.

   b. Bell joint restraint devices for PVC push joint pipe shall be EBAA Iron Inc., Series 1600 for C-900 PVC pipe, Series 2800 for bell restraint on C -905 PVC pipe or Uni-Flange Series 1300, 1360 or 1390 or ROMAC Series 600, Star Pipe Products L.P., or approved equal.

c. C-900 PVC fittings shall be restrained with EBAA Iron Inc., Series 2500 bell restraint for PVC fittings, Star Pipe Products, L.P., or an approved equal.

d. Bolts and nuts shall be Ductile Iron, T-Head type with hexagonal nuts. Bolts and nuts shall be machined through and nuts shall be tapped at right angles to a smooth bearing surface.

B. Concrete for thrust blocks:

1. Compressive Strength: Minimum of 3,700 psi class design strength at twenty-eight days.

2. Concrete shall be Class B conforming to Section 903 of the Standard Specifications.

C. Tracer Wire:

1. Tracer Wire: Wire size shall not be less than 18 AWG, insulation type suitable for direct burial, color to be blue.

SECTION 3 – EXECUTION

3.01 METHODS OF CONSTRUCTION

A. Submittals:

1. Manufacturer's literature and recommendations:

a. Submit manufacturer's descriptive literature for all materials to be used.

b. Submit pipe manufacturer's recommended method for gasket installation.

2. Certificates:

a. Submit manufacturer's certified letter stating that pipe or joint material ordered meets requirements of this specification. Letter shall indicate compliance with appropriate reference standards listed.

3. Submit eight (8) copies of all shop drawings/certificates prior to installing materials.

B. Product delivery, storage and handling:

1. Storage of materials:

a. Store materials to prevent physical damage.

b. Store pipe and fittings off ground to prevent dirt and debris from entering.

c. Store flexible gasket materials and joint primer or adhesive compounds, in cool, dry place. Keep rubber gasket clean, away from oil, grease, excessive heat and out of direct rays of sun.

2. Handling of materials:

   a. Protect materials during transportation and installation to avoid physical damage.

   b. Use extra care in cold weather when flexibility and impact resistance of PVC pipe is reduced.

   c. Do not install out-of-round pipe.

   d. Unload pipe to prevent abrasion.

   e. Do not drag or push pipe when handling or distributing on project site.

C. Inspection by Contractor:

1. Inspect pipe for defects prior to placement in trench. The pipe and fittings shall be free from visible cracks, holes, foreign inclusions or other injurious defects. Assure that all materials are of the type specified and are not defective. Pipe and materials not meeting specification requirements shall be removed from the site as directed by the Engineer.

D. Installation:

1. Excavation and backfill for pipes shall conform to the specification Section 312333 entitled "Excavation and Backfill"

2. Lay pipe to lines shown on drawings. Establish a minimum cover of forty two inches (42”) over the top of the pipe measured from finished grade, unless otherwise directed by the Engineer.

3. Do not lay pipe on unsuitable material, in wet trench, or in same trench with another pipe or utility.

4. All pipe and fittings shall be cleaned of all dirt and other debris before being installed and shall be kept clean until accepted in the completed work.

5. General Procedure for Joining Pipe:

   a. <u>DO NOT USE EXCAVATING EQUIPMENT TO CONNECT PIPE SECTIONS TOGETHER.</u>

   b. Clean ring groove in bell end of pipe prior to inserting rubber gasket seal.

   c. Clean and lubricate spigot end of pipe. Lubricate spigot end of pipe only.

   d. Hold pipe securely and in proper alignment when joining.

   e. Do not disturb previously made joints. Check completed piping to assure joints are intact. Insure placement of backfill over pipe is accomplished without disturbing pipe position.

f. Join pipe so that reference mark on spigot end, if provided by manufacturer, is flush with end of bell.

g. Except where necessary making connection with other lines and as authorized by the Engineer, pipe shall be laid with the bells facing in the direction of laying, and for lines on the appreciable slope bells shall, at the direction of the Engineer, face upgrade.

h. The method of installing joint materials and joining pipe shall be in strict accordance with the manufacturer's printed instructions. The above joining procedures shall be considered as a general guide.

6. Pipe cuts shall be made square using PVC pipe cutter, miter box, fine-toothed hand saw or other approved tools as recommended by the pipe manufacturer. Bevel ends using factory-finished beveled end as a guide.

7. Maintain minimum of eighteen inch (18") minimum clearance between outside surface of pipe and outside surface of other pipes and structures and a minimum of ten feet (10') clearance between the outside surface of the pipe and sanitary sewer mains. When this clearance cannot be obtained, contact the Engineer for instructions prior to proceeding with the pipe installation.

8. Seal open pipe end with approved plugs whenever work is stopped. Remove plug prior to beginning work, inspect and clean pipe.

9. Drainage of trench water through pipe shall not be permitted.

10. Under no circumstances will pipe be laid in water and no pipe shall be laid when trench conditions or the weather is unsuitable for such work, except by permission of the Engineer.

11. Provide concrete thrust blocks at all bends, tees, crosses, reducers, stops, and valves to prevent movement of pipe under pressure. Thrust blocks shall be poured against undisturbed earth where firm support can be obtained.

12. Taps: Tapped connections shall be made on forty-five degree angle from top of main by means of a saddle or tapped coupling.

13. Test, disinfect and backfill pipe and appurtenances as specified in Section 330112 and in accordance with AWWA standards and having jurisdiction.

14. No defective pipe, fittings, or other materials shall be laid or placed in the piping. Any material discovered to be defective after having been laid shall be removed and replaced with satisfactory material by the Contractor at his expense.

15. Install warning tape over water main and tracer wire attached to water main with tape every 5 feet. Tracer wire shall have locator wire that can be located at grade.

E. Testing

1. In accordance with Section 330112 "Testing Procedure for Public Water Supply Systems."

END OF SECTION

SECTION 330533.13

CORRUGATED-WALL, SMOOTH INTERIOR HDPE GRAVITY PIPE

PART 1 - DESCRIPTION

A. Furnish and install high density polyethylene culvert pipe and underdrain as shown on the plans and specified herein.

PART 2 - MATERIALS

A. H.D.P.E. Drainage Pipe:

1. The pipe shall be high density polyethylene pipe with an integrally formed waterway as manufactured by A.D.S. or approved equal and conforming to AASHTO M252 Type S Pipe 12" and larger shall meet the requirements stipulated by AASHTO M294, Type S or ASTM F2306.

2. Material for pipe and fitting production shall be high-density polyethylene conforming with the minimum requirements of cell classification 424420C for 4- through 10-inch (100 to 250 mm) diameters, and 435400C for 12- through 60-inch (300 to 1500 mm) diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. The 12- through 60-inch (300 to 1500 mm) pipe material shall comply with the notched constant ligament-stress (NCLS) test as specified in Sections 9.5 and 5.1 of AASHTO M294 and ASTM F2306, respectively.

3. Pipe shall be joined using a bell & spigot joint meeting the requirements of AASHTO M252, AASHTO M294, or ASTM F2306. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. Gaskets shall meet the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly. 12- through 60- inch (300 to 1500 mm) diameters shall have an exterior bell wrap installed by the manufacturer.
   Fittings shall conform to AASHTO M252, AASHTO M294 or ASTM F2306. Bell and spigot connections shall utilize a welded bell and valley or saddle gasket meeting the watertight joint performance requirements of AASHTO M252, AASHTO M294 or ASTM F2306.
   To assure watertightness, field performance verification may be accomplished by testing in accordance with ASTM F2487. Appropriate safety precautions must be used when field testing any pipe material. Contact the manufacturer for recommended leakage rates.

4. End plugs shall be furnished at all underdrain terminations.

5. All standard and non-standard fittings shall be fabricated by same manufacturer of pipe unless approved by the Engineer.

6. Rubber gasket shall meet ASTM F477 specifications.

7. Perforated Corrugated polyethylene heavy duty underdrain pipe shall be type SP AASHTO M252. All perforation patterns shall meet Class 2 requirements of AASHTO M294 or AASHTO MP7, latest edition.

8. Pipe shall be smooth walled, Advanced Drainage Systems, N-12 ProLink WT (Water tight joints) with built-in bell joint, or approved equal.

B. Crushed Stone:

1. Crushed stone shall be #57 size broken stone or washed gravel.

C. Filter Fabric:

1. Filter fabric shall be Mirafi 140NL or approved equal.

PART 3 - METHOD OF CONSTRUCTION

A. HDPE Drainage Pipe:

1. Lay pipe only in presence of Engineer. Engineer may order removal and relaying of pipe not so laid.

2. Finish grade trench bottom so that pipe is supported for its full length.

3. The pipe and fittings shall be free of foreign inclusions and visible defects. The ends of the pipe shall be cut squarely and cleanly so as not to adversely affect joining.

4. Method of installing couplings and joining pipe shall be in strict accordance with manufacturer's printed instructions. The above joining procedures shall be considered as a general guide. Any above requirement which conflict with the manufacturer's printed instructions as approved by the Engineer shall be void to the extent of such conflict.

END OF SECTION

SECTION 331153

MONITORING WELLS

SECTION 1 - GENERAL

1.01 DESCRIPTION

A. Furnish and install a replacement monitoring well and decommission the existing monitoring well in accordance with New Jersey Department of Environmental Protection (NJDEP) requirements. The new well shall match the exiting well.

1.02 SUBMITTALS

A. New Jersey Well Driller's License.

B. New Jersey Well Permit

C Well Decommissioning report and NJDEP approval

SECTION 2 - MATERIALS

2.01 MATERIALS

A. In accordance with NJDEP requirements.

SECTION 3 - EXECUTION

3.01 METHODS OF CONSTRUCTION

A. Drilling.

(1) Monitoring wells must be drilled by a New Jersey-licensed driller who is qualified to drill and install monitoring wells. The installation and development shall be supervised by a licensed professional geoscientist or engineer. All well permits must be submitted to the New Jersey Department of Environmental Protection prior to the commencement of drilling.

(2) The well shall be drilled by a method that will allow installation of the casing, screen, etc., and that will not introduce contaminants into the borehole or casing. Drilling techniques used for boring shall take into account the materials to be drilled, depth to groundwater, total depth of the hole, adequate soil sampling, and other such factors that affect the selection of the drilling method. If any fluids are necessary in drilling or installation, then clean, treated city water shall be used; other fluids must be approved in writing by the LSRP of Record before use.

(3) The diameter of the boring shall be at least four inches larger than the diameter of the casing. When the boring is in hard rock, a smaller annulus may be approved by the LSRP of Record.

(4) A log of the boring shall be made by or under the supervision of a professional environmental scientist, geoscientist or engineer who is familiar with the geology of the area.

(5) Casing, screen, filter pack, and seals.

(A) The well casing shall be: two to four inches in diameter; National Science Foundation-certified polyvinyl chloride (PVC) Schedule 40 or 80 pipe, flush-thread, screw joint (no glue or solvents); polytetrafluorethylene (PTFE, such as Teflon), Per- and Polyfluoroalkyl Substances (PFAS), tape or O-rings in the joints; no collar couplings. The casing shall be cleaned and packaged at the place of manufacture; the packaging shall include a PVC wrapping on each section of casing to keep it from being contaminated prior to installation. The casing shall be free of ink, labels, or other markings. The casing (and screen) shall be centered in the hole to allow installation of a good filter pack and annular seal. The top of the casing shall be protected by a threaded or slip-on top cap or by a sealing cap or screw-plug seal inserted into the top of the casing. The cap shall be vented to prevent buildup of methane or other gases and shall be designed to prevent moisture from entering the well.

(B) The screen shall be compatible with the casing and should generally be of the same material. The screen shall not involve the use of any glues or solvents for construction. Field-cut slots are not permitted for well screen. Filter cloth shall not be used. Selection of the size of the screen opening should be done by a person experienced with such work and shall include consideration of the distribution of particle sizes both in the water-bearing zone and in the filter pack surrounding the screen. The screen opening shall not be larger than the smallest fraction of the filter pack.

(C) The filter pack, placed between the screen and the well bore, shall consist of prepackaged, inert, clean silica sand or glass beads; it shall extend from one to four feet above the top of the screen. Open stockpile sources of sand or gravel are not permitted. The filter pack usually has a 30% finer grain size that is about four to ten times larger than the 30% finer grain size of the water-bearing zone; the filter pack should have a uniformity coefficient less than 2.5. The filter pack should be placed with a tremie pipe to ensure that the material completely surrounds the screen and casing without bridging. The tremie pipe shall be steam cleaned prior to the first well and before each subsequent well.

(D) The annular seal shall be placed on top of the filter pack and shall be at least two feet thick. It should be placed in the zone of saturation to maintain hydration. The seal should be composed of coarse-grain sodium bentonite, coarse-grit sodium bentonite, or bentonite grout. Special care should be taken to ensure that fine material or grout does not plug the underlying filter pack. Placement of a few inches of prepackaged clean fine sand on top of the filter pack will help to prevent migration of the annular seal material into the filter pack. The seal should be placed on top of the filter pack with a steam-cleaned tremie pipe to ensure good distribution and should be tamped with a steam-cleaned rod to determine that the seal is thick enough. The bentonite shall be hydrated with clean water prior to any further activities on the well and left to stand until hydration is complete. If a bentonite-grout (without cement) casing seal is used in the well bore, then it may replace the annular seal described in this paragraph.

(E) A casing seal shall be placed on top of the annular seal to prevent fluids and contaminants from entering the borehole from the surface. The casing seal shall consist of a commercial bentonite grout or a cement-bentonite mixture. Drilling spoil, cuttings, or other native materials are not permitted for use as a casing seal. Quick-setting cements are not permitted for use because contaminants may leach from them into the groundwater. The top of the casing seal shall be between five and two feet from the surface.

(6) Protective manhole. A steel or epoxy-coated cast iron bolt-down manhole with skirt shall be placed around the top of the well casing to protect it from damage and unwanted entry. The concrete pad shall be constructed around the manhole and skirt, and the manhole surface and concrete pad shall be flush with the surrounding surface. The well permit number and well identification number shall be marked permanently on the manhole.

(7) Concrete pad. High-quality structural-type concrete shall be placed from the top of the casing seal continuously to the top of the ground to form a pad at the surface. This formed surface pad shall be at least six inches thick and not less than four feet square or five feet in diameter. The pad shall contain sufficient reinforcing steel to ensure its structural integrity in the event that soil support is lost. The top of the pad shall slope away from the well bore to the edges to prevent ponding of water around the casing or collar.

(8) Development. After a monitoring well is installed, it shall be developed to remove artifacts of drilling (clay films, bentonite pellets in the casing, etc.) and to open the water-bearing zone for maximum flow into the well. Development should continue until all of the water used or affected during drilling activities has been removed and field measurements of pH, specific conductance, and temperature have stabilized. Failure to develop a well properly may mean that it is not properly monitoring the water-bearing zone or may not yield adequate water for sampling even though the water-bearing zone is prolific.

(9) Location and elevation. Upon completion of a monitoring well, the location of the well and all appropriate elevations associated with the top-well equipment shall be surveyed by a registered professional surveyor. The elevation shall be surveyed to the nearest 0.01 foot above mean sea level (with year of the sea-level datum shown). The point on the well casing for which the elevation was determined shall be permanently marked on the casing. The location shall be given in terms of the latitude and longitude at least to the nearest tenth of a second and NJ State Plane X & Y Coordinates.

(1) Reporting. Monitoring well installation and construction details must be submitted on forms available from the New Jersey Department of Environmental Protection (NJDEP) and must be completed and submitted within 30 days of well completion. A copy of the detailed geologic log of the boring, a description of development procedures, any particle size or other sample data from the well, and a site map drawn to scale showing the location of all monitoring wells and the point of compliance must be submitted to the LSRP of Record at the same time. The licensed driller should be familiar with the forms required by other agencies; a copy of those forms must also be submitted to the applicable agencies and LSRP of Record.

(11) Damaged wells. Any monitoring well that is damaged to the extent that it is no longer suitable for sampling shall be reported to the LSRP of Record, who may make a determination about whether to repair or replace the well.

(12) Plugging and abandonment. Any monitoring well that is no longer used shall be properly abandoned and plugged in accordance with NJAC 7:9D. No abandonment shall take place without prior authorization in writing by the LSRP of Record.

(13) All drilling cuttings and development purge water shall considered contaminated and regulated for transportation and disposal. All drill cuttings and well development purge water shall be containerized and disposed of off-site at a applicable regulated disposal facility registered to accept contaminated material.

END OF SECTION

SECTION 331413

DUCTILE IRON WATER MAIN AND FITTINGS

SECTION 1 - GENERAL

1.01 DESCRIPTION

A. Furnish and install Ductile Iron Water Main and Fittings for proposed potable water distribution system complete as shown on the plans and specified herein.

1.02 SUBMITTALS

A. Contractor shall supply six copies of shop drawings for all pipe and fittings for approval prior to installation.

B. Submit six (6) copies of manufacturer's certified letter stating that the pipe or joint materials ordered meets the requirements of this specification. Letter shall indicate compliance with appropriate reference standards listed.

1.03 QUALITY ASSURANCE

A. Testing of Pipe - All Ductile Iron Pipe shall be tested by the manufacturer in accordance with ANSI Spec A21.51 and shall have Underwriters Laboratory approval. Manufacturer shall validate other than certification, the ductility of each length of pipe by an Underwriters Laboratory approved method.

SECTION 2 - MATERIALS

2.01 MATERIALS

A. Ductile Iron Water Main and Fittings - Below Grade

1. Pipe shall be cement lined Class 52 as specified on drawings, Ductile Iron Pipe with push on joints conforming to AWWA C151.

2. Fittings: Fittings shall be mechanical joint cast iron or ductile iron fittings in accordance with AWWA C110. All fittings shall be cement mortar lined in accordance with AWWA C104, latest edition. All joints at fittings shall be restrained with 1100 Series or Series 2000PV as applicable MEGALUG Mechanical Joint Restraints and concrete thrust blocks as per the plans.

3. Jointing Materials: All jointing materials shall be as furnished by manufacturer of pipe and fittings and as specified above. All jointing materials shall be in accordance with AWWA C111.

B. Ductile Iron Water Main and Fittings – Above Grade/Exposed

1. Pipe shall be cement lined Class 53 Ductile Iron Pipe with flanged joints conforming to AWWA C115.

2. Fittings shall be cement lined flanged fittings conforming to AWWA C110, Pressure Class 250.

C. Cement-mortar lining for pipe and fittings shall conform to AWWA C104.

D. Concrete for thrust blocks:

1. Compressive Strength: Minimum of 3,700 psi at twenty-eight days.
2. Concrete shall be Class B conforming to Section 914 of the New Jersey Department of Transportation Standard Specifications.

SECTION 3 - EXECUTION

3.01 METHODS OF CONSTRUCTION

A. General - All ductile iron pipe shall be installed in accordance with the details shown on the drawings unless otherwise hereinafter specified and all excavation and backfill shall conform to the requirements herein specified.

B. Handling Ductile Iron Pipe & Accessories - All ductile iron pipe and accessories shall be new material which has at no time previously been used for any purpose whatsoever. Pipe and accessories shall be handled in such a manner to insure delivery on the work in sound, undamaged condition and conforming in all respects to these specifications. Particular care shall be taken not to injure the pipe coating. No other pipe or material of any kind shall be placed inside of any pipe or fittings at any time after the coating has been applied.

C. Placing Pipe in Trench - The interior of all pipe shall be thoroughly cleaned of all foreign matter before being lowered into the trench and shall be kept clean during laying operations by means of plugs or other approved methods. No trench water shall be allowed to enter the pipe or fittings. At all times when work is not in progress, all open ends of pipes and fittings shall be securely closed to the satisfaction of the Engineer.

D. Laying Pipe - The spigot shall be centered in the bell, the pipe centered home and brought into true and specified alignment.

Except where necessary in making connection with other lines and as authorized by the Engineer, pipe shall be laid with the bells facing in the direction of laying, and for lines on the appreciable slope bells shall, at the direction of the Engineer, face upgrade. Under no circumstances will pipe be laid in water and no pipe shall be laid when trench conditions or the weather is unsuitable for such work, except by permission of the Engineer.

E. Cutting Pipe - Cutting the pipe for closure pieces or for other reasons shall be done by a method which will not damage the pipe lining. Unless otherwise authorized by the Engineer, all cutting of pipes shall be done by means of mechanical cutters of an approved type or types. Wheel cutters shall be used wherever practicable.

F. Mechanical Joint - Mechanical joint shall be made by accurately centering the spigot in the bell. All surfaces with which rubber cement comes in contact shall be thoroughly

cleaned by brushing with a wire brush just prior to the assembling. Brushing shall be such as to remove any foreign materials, loose rust so as to provide clean and smooth surfaces. Bolts shall be drawn by means of an indicating torque wrench and the torque applied shall be recommended for the various size bolts used and by the manufacturer of the pipe. Tightening of bolts shall be done in such a manner so that the gland is brought forward to the pipe flange evenly and kept at approximately the same distance from the flange around the entire circumference of the joint. Under no circumstances will overstressing of the bolts be permitted in order to tighten the joint, and in such case the joint shall be taken apart and reassembled after thorough cleaning.

G. All buried bolts, studs, retainer plates, nuts and washers shall be provided with two coats of bitumastic paint before backfilling.

H. Testing -

1. All joints in pipe lines shall remain uncovered until the pipe has been subject to pressure tests of 150 lbs. per square inch. When all joints being subjected to the test are found to be tight at this pressure, in the presence of the Engineer, the test may be stopped and backfilling commenced, as herein specified. The cost of testing of the pipe lines shall be borne by the Contractor who must furnish all necessary equipment, labor and materials for the tests. Pressure shall remain constant on the pipe for at least 2 hours and shall not drop more than 5 pounds in 2 hours. The maximum amount of makeup water that can be added shall be as follows:

Test Pressure	Nominal Pipe Diameter (Inches)	Allowable Leakage Per 1000 feet of Pipe (GPH)
150 PSI	3	0.28
	4	0.37
	6	0.55
	6	0.74
	10	0.92
	12	1.10
	14	1.29
	16	1.47
	18	1.66
	20	1.84
	24	2.21
	30	2.76
	36	3.31

2. Acceptance shall be determined based on the amount of makeup water to be added to the pipe being tested. If any test of pipe has leakage greater than the specified amount the Contractor shall locate and make repairs as necessary until the leakage is within the specified allowance.

3. All visible leaks shall be repaired regardless of the amount of leakage. Defective joints, pipe and fittings shall be removed and replaced by the Contractor.

4. The Contractor shall test the pipe line in sections. Test pressure shall not be applied to existing water service.

5. Sections of main shall be tested before connection to existing mains. At connections to existing mains, existing static pressure shall be applied for test. No joints shall be covered until tested in presence of Engineer.

6. Refer to Section 330112 of these specifications for further details.

G. Bracing the Pipe at Bends – All fittings at bends in the pipe lines shall be firmly wedged between the fittings and the vertical face of the trench in order to prevent the fittings from being blown off the line when under pressure by means of a 1-2-4 concrete mix except at plugs where wood block shall be used. Where a firm trench is not present, Contractor shall provide tie rods coated with Bitumastic Paint at no additional cost to the Owner.

END OF SECTION

SECTION 331417

WATER SERVICE LINE - COPPER

SECTION 1 - GENERAL

1.01 DESCRIPTION

Install new water service lines, including all necessary adjustments to make complete connection as specified herein where shown on the plans or as directed by the engineer.

SECTION 2 – MATERIALS

2.01 MATERIALS

A. Acceptable Manufacturers:

1. The products of Mueller Company, Decatur, Ill, AMETEK Inc., Sheboygan, WI and JCM Industries, Inc., Nash, TX as specified in the following paragraphs, are used to establish standards of quality. Other manufacturers' materials may be used provided they are approved as an equivalent product.

B. Seamless Copper water tube: ASTM B88-77 3" Type K annealed, furnished straight or in coils.

G. Fittings: compatible with copper tube and tapping sleeve and valve

H. Service Saddle JCM Industries Series 406 Fusion plastic coated ductile iron double strap stainless steel service saddle.

SECTION 3 – EXECUTION

3.01 METHODS OF CONSTRUCTION

A. Installation

1. Workmanship:

a. Examine pipe, fittings, tapping sleeve and valves before installation to assure no defective materials are incorporated.

2. Placement:

a. Lay piping on firm bed for entire length of trench except where supports are otherwise provided.

b. Employ partial backfilling and cradling to hold pipe in secure position during backfilling operations.

c. Backfill evenly on both sides of pipe to maintain equipment.

d. Anchor piping laid on grade prior to embedment in concrete.

e. Install pipe at 90 degrees to the water main.

3. Bending pipe:

a. Bend pipe by any method to any radius within manufacturer's recommendations.

b. Only bend surface free of cracks and buckles.

B. Tapping Sleeve and Valve:

1. Install tapping sleeve and valve in accordance with Section 331419

C. Testing:

1. Disconnect all equipment and devices, which may be damaged by, test pressures.

2. Plug or cap lines.

3. Test and disinfect each piping system.

4. Repair all leaks.

END OF SECTION

SECTION 331419

WATER MAIN VALVES & PIPING APPURTENANCES

SECTION 1 - GENERAL

1.01 DESCRIPTION

A. Provide gate valves as specified herein and shown on the drawings.

B. Provide complete fire hydrant assemblies as specified herein and shown on the drawings.

C. Provide tapping valves and sleeves as specified herein and shown on the drawings.

1.02 SUBMITTALS

A. Contractor shall supply shop drawings for approval prior to installation as required in Section 013000. Any installation installed without approval shall be installed at the Contractor's risk and shall be removed if found UNACCEPTABLE.

SECTION 2 - MATERIALS

2.01 MATERIALS

A. Gate Valves shall be mechanical joint, resilient wedge iron body gate valves AWWA non-rising stem, open left, 2"-12" 200 psi, 14" and up 150 psi working pressure with cast iron telescopic valve boxes with cover marked "Direction of Opening." Gate valves and valve boxes shall be as manufactured by Mueller Company or equal and shall conform with standards of water department of the Owner.

B. Fire Hydrants

Shall be the Mueller Company's 4 1/2" Centurion Fire Hydrant Model A-421 as indicated on the plans. Hydrants shall be supplied with a mechanical joint for connection to 6" pipe. Hydrants shall be equipped with the Harrington Permanent Hydrant Adapter - Metal Face Storz adapter with female thread, secured permanently to the hydrant, including Storz blind cap with suction seal and aircraft cable.

1. Ductile Iron Pipe and Fittings shall conform to Section 331413 of these specifications with the cost of furnishing and installation of connecting pipe and fittings from main to hydrant included in amount bid for Hydrant.

2. Gate Valves shall be as heretofore specified except cost of furnishing and installation of gate valve and valve box in connecting pipe from main to hydrant shall be included in the amount bid for Hydrant.

C. Tapping Sleeves & Valves

1. Tapping sleeves and tapping crosses shall be mechanical joint type in accordance with the type of joint specified for water mains heretobefore. Tapping sleeves and crosses shall have ASA 125 lb. outlet flanges. Tapping sleeves and crosses shall be as manufactured by Mueller or approved equal.

2. Tapping valves shall be of same construction as AWWA 175 lb. valves cast iron, Non Rising Stem (NRS). resilient wedge gate valves with inlet end 125 lb. flange or attachments to tapping sleeves or cross end with outlet end mechanical joint with type of joint as specified heretobefore for water main. Tapping sleeves shall be equipped with valve boxes as specified for valves and valve boxes heretobefore. Unless otherwise directed by the Owner, the direction of opening shall be left. Tapping valves and valve boxes shall be as manufactured by Mueller or approved equal.

NOTE: Any changes or substitutions will be at the discretion of the Department of Public Works and the Engineer

SECTION 3 - EXECUTION

3.01 METHODS OF CONSTRUCTION

A. Gate Valves

Handling, installation, jointing and tests shall be as specified for Water Main. All valves shall have stuffing boxes tightened if required and valves open and closed to see that all working parts are in order. Valves shall be set on blocking to ensure position while pouring and to prevent strain on connecting pipe or joints. Valve boxes shall be set directly over valve in vertical position.

Fill around valve box by tamping in 8” layers. Reset valve boxes before final grading if required and clean out valve box of all foreign material so as to provide ease of operation.

B. Fire Hydrants

Hydrants shall be set accurately and shall be truly plumb as well as being set at a depth for which the hydrant was made. Contractor shall take all precautions and make every effort to ensure that the interior of hydrant, valve and drip or drain valve are cleaned and free from all obstructions. Hydrants shall be solid blocked to the undisturbed earth at the end of the trench opposite the water main connection by means of concrete blocking, placed in such a manner as to withstand thrust of water pressure and with care not to interfere with drainage from drip valve. Similar blocking shall be used back to tee to each hydrant branch in the water main. Unless otherwise directed, hydrants shall be set 24” from face of curb to centerline of hydrant. All hydrants shall be set with openings 90 degrees to curb line. All concrete sidewalk and curb, disturbed or damaged by construction, shall be replaced and included in the cost of the fire hydrant assembly.

C. Tapping Valves & Sleeves

Excavation and backfill shall be as heretobefore specified. Adequate space shall be provided for installation of sleeve and tapping valve with machine. All surface on old pipe must be thoroughly prepared. The trench must be kept dry. Contractor shall determine exact location of existing main and other utilities before laying pipe. Tapping sleeves and crosses shall be located free of all services and joints in existing main. The complete installation including tapping sleeves and valves shall be watertight under static pressure. Only experienced personnel shall be used on the work. Any damage to existing main shall be the responsibility of the Contractor. The complete installation shall be in accordance with recommendations and directions of the manufacturer of the tapping machine used. Prior to tapping main, the Contractor and Water Superintendent shall mutually agree as to when the work shall be performed. Plugs removed from existing mains shall be delivered to water plant. The existing main shall be adequately supported during operation. Should the "cutting in" be unsuccessful through the use of tapping sleeves and crosses, Contractor shall, at no cost to Owner, furnish and install each side of the point of connection, an inserted valve under pressure as manufactured by Mueller or approved equal and make a dry connection.

All joints on all connections shall be as specified heretobefore for water mains. Valves and valve boxes shall be plumb. Connection shall be sterilized as specified for water main.

END OF SECTION

State of New Jersey
Department of Transportation

Special Provisions To The 2019 Standard Specifications For Road and Bridge Construction

FY 2019 Edition

SPECIAL PROVISIONS
FOR
TO THE 2019 STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION
FOR THE
PUBLIC WORKS BUILDING
IN THE
CITY OF MARGATE CITY
COUNTY OF ATLANTIC

AUTHORIZATION OF CONTRACT

The Contract for this project is authorized by the provisions of local public contracts law, NJSA 40A: 11-1 et seq.

SPECIFICATIONS TO BE USED

The 2019 Standard Specifications for Road and Bridge Construction, of the New Jersey Department of Transportation (Department) as amended herein will govern the construction of this Project and the execution of the Contract.

These Special Provisions consist of the following:

Pages 1 to 33 inclusive.

State wage rates may be obtained from the New Jersey Department of Labor & Workforce Development (Telephone: 609-292-2259) or by accessing the Department of Labor & Workforce Development's website at https://www.nj.gov/labor/wagehour/wagerate/prevailing_wage_determinations.html. The State wage rates in effect at the time of award are part of this Contract, pursuant to Chapter 150, Laws of 1963 (N.J.S.A. 34:11-56.25 et seq.).

In the event it is found that any employee of the contractor or any subcontractor covered by the contract, has been paid a rate of wages less than the minimum wage required to be paid by the contract, the contracting agency may terminate the contractor's or subcontractor's right to proceed with the work, or such part of the work, as to which there has been a failure to pay required wages and to prosecute the work to completion or otherwise. The contractor and his sureties shall be liable to the contracting agency for any excess costs occasioned thereby.

GENERAL

Award of contract and subletting will not be permitted to, materials will not be permitted from, and use of equipment will not be permitted that is owned and/or operated by, firms and individuals included in the report of suspensions, debarments and disqualifications of firms and individuals as maintained by the Department of the Treasury, Division of Purchase & Property, Contract Compliance & Administration, Trenton NJ 08625 (609-292-5400).

Payment for a pay item in the proposal includes all the compensation that will be made for the work of that item as described in the contract documents unless the "measurement and payment" clause provides that certain work essential to that item will be paid for under another pay item.

Whenever any section, subsection, subpart or subheading is amended by such terms as changed to, deleted or added it is construed to mean that it amends that section, subsection, subpart or subheading of the 2019 Standard Specifications unless otherwise noted.

Whenever reference to page number is made, it is construed to refer to the 2019 Standard Specifications unless otherwise noted.

Henceforth in this supplementary specification whenever reference to the State, Department, ME, RE or Inspector is made, it is construed to mean the particular municipality or county executing this contract.

Whenever reference to Title 27 is made, it is construed to mean Title 40.

Separate payment will not be made for any work in the New Jersey Department of Transportation Standard Specifications for Road and Bridge Construction or Special Provisions. Payment will be made for any work under the appropriate lump sum items in the bid form.

DIVISION 100 – GENERAL PROVISIONS

THE FOLLOWING SECTIONS OF THE STANDARD SPECIFICATIONS ARE DELETED:

SECTION 101 – GENERAL INFORMATION
SECTION 102 – BIDDING REQUIREMENTS AND CONDITIONS
SECTION 103 – AWARD AND EXECUTION OF CONTRACT
SECTION 104 – SCOPE OF WORK
SECTION 105 – CONTROL OF WORK
SECTION 106 – CONTROL OF MATERIAL
SECTION 107 – LEGAL RELATIONS
SECTION 108 – PROSECUTION AND COMPLETION
SECTION 109 – MEASUREMENT AND PAYMENT
SECTION 151 – PERFORMANCE BOND AND PAYMENT BOND
SECTION 152 – INSURANCE
SECTION 153 – PROGRESS SCHEDULE
SECTION 154 – MOBILIZATION
SECTION 155 – CONSTRUCTION FIELD OFFICE
SECTION 156 – MATERIALS FIELD LABORATORY AND CURING FACILITY

These sections of the standard specifications are changed to the requirements of the contracting agency contained here in these contract construction specifications document.

SECTION 157 – CONSTRUCTION LAYOUT AND MONUMENTS

157.04 MEASUREMENT AND PAYMENT

THE ENTIRE SECTION IS CHANGED TO:

SEPARATE PAYMENT WILL NOT BE MADE FOR CONSTRUCTION LAYOUT

SECTION 158 – SOIL EROSION AND SEDIMENT CONTROL AND WATER QUALITY CONTROL

158.03.02 SESC Measures

19. Oil-Only Emergency Spill Kit.

158.04 MEASUREMENT AND PAYMENT

THE ENTIRE SECTION IS CHANGED TO:

SEPARATE PAYMENT WILL NOT BE MADE FOR SOIL EROSION CONTROL AND WATER QUALITY CONTROL.

SECTION 159 – TRAFFIC CONTROL

159.02.01 Materials
THE FIRST ITEM IS CHANGED TO:

Tack Coat 64-22 ..... 902.01.01

159.03.01 Traffic Control Coordinator

THE FIRST PARAGRAPH BEFORE THE LIST IS CHANGED TO:

Before starting Work, submit to the RE the name, training, work experience, and contact information of an employee assigned as the on-site Traffic Control Coordinator (TCC). The TCC must be certified as having successfully completed the Rutgers CAIT Traffic Control Coordinator Program, or an equivalent course as approved by the NJDOT Office of Capital Project Safety. The TCC must also successfully complete an approved Traffic Coordinator refresher course every 2 years. The TCC is a full-time position and the employee designated as TCC must be available on a 24 hour a day, 7 days a week basis. The TCC shall have the responsibility for and authority to implement and maintain all traffic operations for the Project on behalf of the Contractor. Ensure that the TCC is present at the work site at all times while the Work is in progress. The TCC's responsibilities and duties shall include the following:

159.03.02 Traffic Control Devices
THE FIRST PARAGRAPGH IS CHANGED TO:

Ensure that FHWA category 1, 2, 3, and 4 traffic control devices (TCDs) conform to the requirements of the 2016 Edition of the Manual for Assessing Safety Hardware (MASH), except that TCDs manufactured on or before December 31, 2019 must have been purchased by the Contractor on or before December 31, 2019, and conform to the requirements of NCHRP 350, MASH 2009, or MASH 2016. Provide each device's applicable MASH 2016, MASH 2009, or NCHRP 350 test results and FHWA Eligibility letter, if issued by the FHWA, to the RE. Provide the RE with the purchase date certification for devices not meeting the MASH 2016 requirements upon delivery to the site. Ensure that traffic control devices meet or exceed an acceptable condition as described in the ATSSA guide Quality Standards for Work Zone Traffic Control Devices. Traffic control devices need not be new but must be in good condition. Provide traffic control devices according to MUTCD.

2. Construction Barrier Curb.
THE SECOND PARAGRAPH IS CHANGED TO:

At least 30 days before delivering construction barrier curb to the Project Limits, provide the RE notice that the barrier curb is available for inspection. Ensure the barrier curb is not stacked for this inspection. The RE will inspect the barrier curb, along with a Contractor representative, to determine what pieces are not approved for delivery to the Project Limits. Final determination of construction barrier approval will be made at the time of placement at the Project.

PART (5) IS CHANGED TO:

5. Temporary Crash Cushion. Install inertial barrier systems as specified in 611.03.01. Install temporary compressive crash cushions as specified in 611.03.02. Immediately repair or replace crash cushions that become damaged or become inoperable. Begin repair or replacement of the temporary crash cushion within 1 hour of receiving notice of damage from the Department. Ensure that workers assigned to such repair or replacement work continuously until the temporary crash cushion is repaired or replaced. If the Contractor fails to respond

to a damage notification and begin work within 1 hour of notification, or does not continue to work until the temporary crash cushion is repaired or replaced, the Department, will require closure of the adjacent live lane. Lane occupancy charges will be imposed as specified in 108.08 for the period of time the adjacent lane is closed. Should the Department have to respond to a repair with its own forces because of a Contractor's lack of response to a damage notification, the Contractor agrees to pay the Department a sum of $3,000 for costs of mobilizing its forces and equipment. In addition, the Contractor must pay the Department the actual cost of material used for the repair and pay the actual costs of police traffic protection. Maintain an adequate number of replacement parts to repair damaged units at all times. Keep the areas in front, atop, and around the crash cushions clear of snow accumulation of more than 4 inches in depth.

Upon removal of the crash cushion, cut anchor bolts at least 3 inches below the surface of the surrounding roadway. Repair HMA pavement as specified in 401.03.03. Repair concrete pavement as specified in Section 452.

PART 6 IS CHANGED TO:

6. **Traffic Control Truck with Mounted Crash Cushions.** Provide the RE with a copy of the crash cushion manufacturer's recommendations. Provide the RE a certified weigh ticket of the Traffic Control Truck with arrow board and mounted Crash Cushion. Position the traffic control truck to ensure that there is adequate stopping distance after impact and to prevent errant vehicles from traveling around the truck and endangering workers. When used in a fixed position, place manual transmission vehicles in second gear and place automatic transmission vehicles in park. Ensure that the parking brake is set and the wheels are set straight. Do not use traffic control trucks in place of other temporary impact attenuators for more than 24 hours. Relocate the traffic control truck as specified by the TCP, or as directed by the RE. Do not use the truck to carry additional equipment, materials, or debris. When using ballast, ensure that it is secured to the truck. Submit drawings to the RE detailing the manner of securing the ballast, signed and sealed by a Professional Engineer, certifying that it is capable of withstanding the impact forces for which the impact attenuator is rated.

9.159.03.03 Removable Black Line Masking Tape

THE ENTIRE SUBSECTION IS CHANGED TO:

Apply black line masking tape over existing traffic stripes as specified in 159.03.05. Ensure that the black line masking tape completely covers existing stripes. Replace black line masking tape that becomes loose after placement within 2 hours. When black line masking tape is no longer required or directed by the RE, carefully and completely remove without using heat, solvents, grinding, sanding, or water.

159.03.05 Temporary Pavement Marking Tape

THE ENTIRE SUBSECTION IS CHANGED TO:

Install tape according to the manufacturer's recommendations when the weather is favorable as determined by the RE. Do not install the tape during wet conditions. Immediately before marking the pavement surface, clean the surface of dirt, oil, grease, and foreign material, including curing compound on new concrete. Clean the surface 2 inches beyond the perimeter of the marking to be placed.

Install tape on dry surfaces having a surface temperature between 50 °F and 150 °F, when the ambient temperature is at least 50 °F and rising as determined by the National Weather Service (http://www.nws.noaa.gov/). When splicing is required, install the tape using butt splices. Do not overlap the tape.

Tamp the tape for initial adhesion and then apply pressure by driving a truck slowly over the tape several times. Maintain tape by replacing loose or damaged tape within 2 hours. Remove tape when no longer required or when directed by the RE.

The surface must be dry. Do not install tape when precipitation is imminent as determined by the RE. The RE will coordinate with the Contractor to install the tape when there is no anticipated precipitation. Install the tape in continuous lengths of 20 feet or less. Any continuous length of more than 20 feet must be removed and replaced at no cost to the Department. Ensure that the removable tape is capable of being removed manually, intact or in large pieces, at

temperatures above 40 ° F, without the use of solvents, burning, grinding, or blasting and without damage to the underlying surface.

If conditions do not allow for the proper adhesion of the tape, use Latex Traffic Stripes, Latex Traffic Markings Lines, and Latex Traffic Markings Symbols as specified in 159.03.06.

159.03.08 Traffic Direction

PART A IS CHANGED TO:

A. Flagger. Provide a flagger that has received formal training in flagging operations and the proper use of the STOP/SLOW paddle. The flagger must be able to demonstrate the abilities indicated in the current MUTCD and, when requested, demonstrate competency to the RE. Immediately replace flaggers who fail to demonstrate competency with a competent flagger. Ensure that flaggers wear a 360 degree high-visibility retroreflective orange safety garment meeting ANSI/ISEA Class 3, Level 2 standards. Ensure that the flagger is equipped with a STOP/SLOW paddle and follows MUTCD flagging procedures.

PART B IS CHANGED TO:

B. Police. Unless designated as local police at the preconstruction conference, police will be on-duty New Jersey State Police. Police are either provided by the RE as employees of the State, or by the local government as a vendor to the State. The use of police services by the RE does not relinquish or diminish the Contractor's responsibilities for work zone safety.

Submit a request for police services to the RE 72 hours before beginning construction operations.

Activities requiring police services include:

1. Traffic direction through signalized intersections, where the integrity of the existing traffic signal system is impacted or where an override of the signal is required.
2. Temporary closure of all lanes on state highways and interstates.

Police services may be requested as an enhancement to the TCP.

This enhancement includes:

1. Temporary closure of one or more lanes on interstates.
2. Temporary closure of one or more lanes on state highways with a posted speed of 50 miles per hour or higher.

Emergency situations may prevent police from arriving at the scheduled date or time. The RE will not permit construction operations that, by law, require police services if police are unavailable. The Department will not accept claims for interruptions or delays resulting from any failure of police to arrive as requested.

The RE must notify State and local police of cancellations 24 hours in advance. At least 24 hours before the scheduled start of work, notify the RE of any work cancellation for which police services were requested.

159.04 MEASUREMENT AND PAYMENT

THE ENTIRE SECTION IS CHANGED TO:

The Department will not measure Traffic Control. Separate Payment will not be made for Traffic Control.

SECTION 160 – PRICE ADJUSTMENTS

THE ENTIRE SECTION 160 IS DELETED

SECTION 161 – FINAL CLEANUP

161.04 MEASUREMENT AND PAYMENT

THE ENTIRE SECTION IS CHANGED TO:

SEPARATE PAYMENT WILL NOT BE MADE FOR FINAL CLEANUP.

DIVISION 200 – EARTHWORK

SECTION 201 – CLEARING SITE

201.03.01 Clearing Site

PART A IS CHANGED TO:

A. Preparation. Construct SESC measures, as specified in 158.03.02, before clearing site.

THE FIRST PARAGRAPH IN PART B IS CHANGED TO:

B. Clearing and Grubbing. Before beginning excavation or embankment construction, clear the site within the limits of construction. Clear the ground surface of vegetation (trees of various caliper, brush, weeds, roots, matted leaves), small structures not shown on the Plans for demolition, debris, and other objectionable material where its existing position conflicts with the limits of construction. In cut sections, grub out tree stumps within the limits of the total cut area. In fill sections, the Contractor may leave tree stumps extending less than 1 foot above the original ground surface in those areas where the proposed subgrade, or proposed finished grade in non-pavement sections, is greater than 3 1/2 feet above the original ground surface. Grub out tree stumps that lie within 5 feet horizontally or vertically from any proposed structure, pipe, or duct.

201.03.02 Clearing Site, Bridge and Clearing Site, Structure
THE FIRST PARAGRAPH IS CHANGED TO:

Submit a demolition plan detailing the work area, methods, and equipment to be used to the RE for approval 30 days before demolition operations. Clear site within work area as specified in 201.03.01. Remove the substructures of existing structures to at least 3 feet below the natural stream bottom, and remove those parts outside of the stream to at least 2 feet below natural ground surface. Where such portions of existing structures lie wholly or in part within the limits of a new structure, remove them to accommodate the construction of the proposed structure. Only the following equipment is permitted for the work:

201.04 MEASUREMENT AND PAYMENT
THE ENTIRE SECTION IS CHANGED TO:

The Department will not measure Clearing Site. Separate Payment will not be made for Clearing Site.

SECTION 202 – EXCAVATION

202.03.01 Stripping
THE SECOND PARAGRAPH IS CHANGED TO:

Strip vegetation and underlying soil to a depth of 4 to 6 inches below the existing ground surface. Confirm the thickness of stripping with the RE based on field conditions. Temporarily store in stockpiles, as specified in 202.03.03.B, stripped material including excess that is determined suitable for the future use of the Department. The Department will sample and analyze stripped material in stockpiles to determine suitability for use as topsoil. Reuse or dispose of unsuitable stripped material as specified in 202.03.03.C.

202.04 MEASUREMENT AND PAYMENT

THE ENTIRE SECTION IS CHANGED TO:

The Department will not measure Excavation. Separate Payment will not be made for Excavation.

DIVISION 400 – PAVEMENTS

SECTION 401 – HOT MIX ASPHALT (HMA) COURSES

401.02.01 Materials

THE FIRST ITEM IS CHANGED TO:

Tack Coat 64-22, PG 64S-22 ..... 902.01.01

401.03.03 HMA Pavement Repair

THE TITLE AND ENTIRE SUBSECTION IS CHANGED TO:

401.03.03 HMA Repair

A. HMA Pavement Repair. Arrange a project site meeting with the RE to establish the limits of HMA pavement repair. Additional repairs, not delineated on the Plans or by the RE during the project site meeting, may be required if the need is established by the RE.

If potholes are discovered, notify the RE immediately. The RE may immediately direct repairs of small areas. The RE may require further evaluation of a large area to determine the need for additional milling and paving.

Perform HMA repairs as a separate operation before milling, paving, and other surface treatments. The Contractor may request approval of the RE to perform the repair work as one operation with the paving or surface treatment.

HMA repairs may be performed on full depth HMA pavement or on composite pavement (HMA over concrete pavement). For full depth HMA pavement, sawcut existing HMA pavement to a depth of 8 inches. For composite pavement, sawcut existing HMA to a depth of 8 inches or up to the top of concrete, whichever is less. Sawcut lines parallel and perpendicular to the roadway baseline and 3 inches away, at the closest point, from the damaged area to be repaired.

Remove damaged and loose material within the boundary of the sawcuts to form rectangular openings with vertical sides to a depth of 8 inches for HMA pavement, or to the top of concrete for composite pavement. A milling machine may be used to remove damaged pavement to form the repair areas if approved by the RE.

After the existing damaged HMA and loose material has been removed, the RE will examine underlying material to determine its condition.

If the base of the repair area is unbound material, then shape and compact the unbound material to produce a firm and level base.

If water exists in the area, remove the underlying material to the depth as directed by the RE. Place geotextile, then place and compact coarse aggregate to required grade to provide for a minimum 8 inch thick HMA pavement repair. Compact coarse aggregate as specified in 203.03.02.B.3.

If the base of the repair is HMA or concrete pavement, then ensure that the remaining pavement is cleaned and dry prior to applying tack coat.

Apply tack coat at an application rate of 0.15 gallons per square yard to the vertical surfaces and base of the opening. Spread and grade HMA surface course mix in the opening as specified for the roadway surface or a HMA surface course mix approved by the RE. Ensure that the temperature of the HMA when placed is at least 250 °F, and compact as specified in 401.03.07.F. Compact areas not accessible to rollers with a flat face compactor. Compact until the top of the patch is flush with, or 1/8 inch higher than, the adjacent pavement surface.

Reuse removed material as specified in 202.03.03.C.1.

B. HMA Longitudinal Joint Repair. Arrange a project site meeting with the RE to establish the limits of HMA longitudinal repair areas. Additional repairs, not delineated on the Plans or by the RE during the project site meeting, may be required if the need is established by the RE.

Mill 2 feet wide, unless directed otherwise by the RE, centered over the HMA longitudinal joint, rumble strip, longitudinal distress areas or any combination of the three, as shown on the Plans and as directed by the RE. Mill to a minimum 2 inches in depth, or as required to remove the damaged pavement. For distress areas wider than 4 feet, the RE may direct the use of HMA pavement repair as specified in 401.03.03.A.

Clean the milled area as specified in 401.03.01.A. Obtain RE approval of the repair area before proceeding with the repair.

Apply polymerized joint adhesive to the vertical surfaces of the repair area as specified in 401.03.04. Apply tack coat as specified in 401.03.05 at an application rate of 0.15 gallons per square yard to the bottom surface of the repair area. Obtain RE approval of the repair area before proceeding with the repair. Spread and grade Hot Mix Asphalt 9.5M64 Surface Course in the repair area as specified in 401.03.07.E. Ensure that the temperature of the HMA when placed and compacted is at least 250 ºF. Compact as specified in 401.03.07.F, ensuring that the top of the compacted HMA is flush with, or not greater than 1/8 inch higher than, the adjacent pavement surface.

Reuse removed material as specified in 202.03.03.C.1.

401.03.07 HMA Courses

A. Paving Plan.

PART (4) IS CHANGED TO:

4. Lighting plan for night operations as specified in 108.06.

C. Test Strip

REPLACE THE FIRST PARAGRAPH OF THIS SECTION WITH THE FOLLOWING:

Test Strip. Construct a test strip for each HMA mix for contracts with more than a total of 5,500 tons of HMA. For HMA HIGH RAP, construct the test strip at least 14 days prior to production. Test strips are not necessary for temporary pavement. Ensure that the tack coat or prime coat has been placed as specified in 401.03.05 and 401.03.06, before placing HMA. Transport and deliver, spread and grade, and compact as specified in 401.03.07.D, 401.03.07.E, and 401.03.07.F, respectively, and according to the approved paving plan. Construct a test strip for the first 700 to 1,200 square yards placed for each job mix formula. If the paving lot area is less than 700 square yards, the District Local Aid Office may waive the coring requirements. While constructing the test strip, record the following information and submit to the RE:

D. Transportation and Delivery of HMA.

THE SECOND SENTENCE OF THE FIRST PARAGRAPH IS CHANGED TO:

Do not allow trucks to leave the plant within 1 hour of sunset unless lighting for night operations is provided as specified in 108.06.

E. Spreading and Grading.

G. Opening to Traffic.

THE FOLLOWING IS ADDED AFTER THE LAST PARAGRAPH:

Ensure that RPMs are installed and rumble strips are constructed within 14 days of opening each day's surface paving to traffic.

H. Air Void Requirements

FOR LOCAL AID PROJECTS, THIS SUBSECTION IS REPLACED BY THE FOLLOWING.

Pavement lots are defined as approximately 15,000 square yards of pavement in Surface area. If pavement lot area is less than 5000 square yards, the Local Aid District Office may waive the air voids requirements.

The RE will designate an independent testing agency (Laboratory) to perform the quality assurance sampling, testing and analysis. The Laboratory is required to be accredited by the AASHTO Accreditation Program (www.amrl.net). The Laboratory's accreditation must include AASHTO T 166 and AASHTO T 209.

The Laboratory Technician who performs the quality assurance sampling shall be certified by the Society of Asphalt Technologists of New Jersey as an Asphalt Plant Technologist, Level 2.

The Laboratory will determine air voids from 5 (Five) 6 inch diameter cores taken from each lot in random locations within the traveled way and at least one core in each travel lane. The HMA Core Sampling Plan form provided on the Local Aid Website must be utilized by the Laboratory to determine the random locations of the cores. The Laboratory may rerun the random location functions on the HMA Core Sampling Plan form to resolve any conflicts generated by the HMA Core Sampling Plan form and physical limitations of the HMA lot, such as utility conflicts, or the specifications defined herein. The coring locations must be designated by a station and offset, and offsets are taken from the left edge of the pavement in the direction of travel within the lane lines. The Laboratory must disclose the contents of the HMA Core Sampling Plan with the Contractor to assist in the schedule of construction.

The Laboratory will determine air voids of cores from the values for the maximum specific gravity of the mix and the bulk specific gravity of the core. The Laboratory will determine the maximum specific gravity of the mix according to NJDOT B-3 and AASHTO T 209, except that minimum sample size may be waived in order to use a 6-inch diameter core sample. The Laboratory will determine the bulk specific gravity of the compacted mixture by testing each core according to AASHTO T 166.

The Laboratory will calculate the percent defective (PD) as the percentage of the lot outside the acceptable range of 2 percent air voids to 8 percent air voids. The acceptable quality limit is 15 percent defective. For lots in which PD > 15, the Department will assess a negative pay adjustment.

The Laboratory will use and submit to the RE the DS8S-PD form provided on the Local Aid Website and verify manually the PD calculation.

The Laboratory will calculate pay adjustments based on the following:

1. Sample Mean ($\bar{X}$) and Standard Deviation (S) of the N Test Results (X1, X2,…, XN).

$$\bar{X} = \frac{(X_1 + X_2 + \cdots + X_N)}{N}$$

$$S = \sqrt{\frac{(X_1 - \bar{X})^2 + (X_2 - \bar{X})^2 + \cdots + (X_N - \bar{X})^2}{N - 1}}$$

2. Quality Index (Q).

$$Q_L = \frac{(\bar{X} - 2.0)}{S}$$

$$Q_U = \frac{(8.0 - \bar{X})}{S}$$

3. **Percent Defective (PD).** Using NJDOT ST for the appropriate sample size, the Laboratory will determine PD_L and PD_U associated with Q_L and Q_U, respectively. $PD = PD_L + PD_U$

4. **Reduction Per Lot.** Calculate the reduction per lot as specified in Table 401.03.07-3:

Table 401.03.07-3

Reduction in Payment for Nonconformance to Air Void Requirements

Percent Defective (PD) Per Lot	Reduction Per Lot (%)
$0 < PD \leq 15$	0
$15 < PD \leq 30$	0.5
$30 < PD \leq 35$	2
$35 < PD \leq 40$	10
$40 < PD \leq 45$	15
$45 < PD \leq 50$	20
$50 < PD \leq 60$	30
$60 < PD \leq 75$	45
$PD > 75$	Remove & Replace

5. **Outlier Detection.** If $PD < 10$, the Laboratory will not screen for outliers. If $PD \geq 10$, the Laboratory will screen acceptance cores for outliers using a statistically valid procedure. The following procedure applies only for a sample size of 5 or 10.

   1. The Laboratory will arrange the core results in ascending order, in which X_1 represents the smallest value and X_N represents the largest value.
   2. If X_N is suspected of being an outlier, the Laboratory will calculate:

$$R = \frac{X_N - X_{(N-1)}}{X_N - X_1}$$

   3. If X_1 is suspected of being an outlier, the Laboratory will calculate:

$$R = \frac{X_2 - X_1}{X_N - X_1}$$

   4. For N = 5 if R > 0.642, the value is judged to be statistically significant and the core is excluded.
      For N = 10 if R > 0.412, the value is judged to be statistically significant and the core is excluded.

   If an outlier is detected for N = 5 and no retest is warranted, the Contractor may replace that core by taking an additional core at the same offset and within 5 feet of the original station. If an outlier is detected and a retest is justified, take a replacement core for the outlier at the same time as the 5 additional retest cores are taken. If the outlier replacement core is not taken within 15 days, the Laboratory will use the initial core results to determine reduction per lot.

If an outlier is detected for N = 10, the Contractor may replace that core by taking an additional core at the same offset and within 5 feet of the original station. If the outlier replacement core is not taken within 15 days, the Laboratory will use the initial core results to determine the reduction per lot.

6. **Retest.** If the initial series of 5 cores produces a percent defective value of PD ≥ 30 for mainline or ramp lots, or PD ≥ 50 for other pavement lots, the Contractor may elect to take an additional set of 5 cores at random locations chosen by the HMA Core Sampling Plan form. Take the additional cores within 15 days of receipt of the initial core results. If the additional cores are not taken within the 15 days, the Laboratory will use the initial core results to determine the PPA. If the additional cores are taken, the Laboratory will recalculate the reduction per lot using the combined results from the 10 cores.

7. **Removal and Replacement.** If the final lot PD ≥ 75 (based on the combined set of 10 cores or 5 cores if the Contractor does not take additional cores), remove and replace the lot and all overlying work. The replacement work is subject to the same requirements as the initial work.

   For shoulder lots, the Department will assess the calculated reduction per lot instead of removal and replacement. Fog seal the lot as specified in 422.03.01.

I. Thickness Requirements

DELETE THIS SUBSECTION AND REPLACE THIS SUBSECTION'S CONTENTS WITH THE FOLLOWING:
This subsection is deleted. In no instance will a compacted average thickness of less than 1.25 inches be acceptable.

DELETE THIS SUBSECTION AND REPLACE THIS SUBSECTION'S CONTENTS WITH THE FOLLOWING:

Thickness requirements will apply when full-depth, uniform-thickness HMA pavement construction is shown.

Pavement lots are defined as approximately 15,000 square yards of pavement area. The Engineer will not include areas consisting of different HMA mixtures or thicknesses in the same lot. If thickness lot area is less than 5000 square yards, the District Local Aid Office may waive the thickness requirements.

The RE will designate an independent testing agency (Laboratory) to perform the quality assurance sampling, testing and analysis. The Laboratory is required to be accredited by the AASHTO Accreditation Program (www.amrl.net). The Laboratory's accreditation must include AASHTO T 166 and AASHTO T 209.

The Laboratory Technician who performs the quality assurance sampling shall be certified by the Society of Asphalt Technologists of New Jersey as an Asphalt Plant Technologist, Level 2.

The Laboratory will test for thickness using the full-depth cores taken for surface course air voids, evaluated according to NJDOT B-4. The Laboratory will base acceptance on total thickness and thickness of the surface course.

1. **Total Thickness.** The Laboratory will calculate the percent defective (PD) as the percentage of the lot that is less than the design thickness. The Laboratory will consider 25 percent defective as the acceptable quality limit. For lots where PD < 25, the Department will award a positive pay adjustment. For lots where PD > 25, the Department will assess a negative pay adjustment.

   The Department will base total thickness acceptance on the percentage of the lot estimated to fall below the specified thickness as follows

   a. **Sample Mean ($\bar{X}$) and Standard Deviation (S) of the N Test Results (X_1, X_2,..., X_N).** Calculate as specified in 401.03.07.H.1.

$$\overline{X} = \frac{(X_1 + X_2 + \ldots + X_N)}{N}$$

$$S = \sqrt{\frac{(X_1 - \overline{X})^2 + (X_2 - \overline{X})^2 + \ldots + (X_N - \overline{X})^2}{N - 1}}$$

b. Quality Index (Q_I)

$$Q_L = \frac{(\overline{X} - T_{des})}{S}$$

Where T_{des} = design thickness.

c. Percent Defective (PD). Using NJDOT ST for the appropriate sample size, determine the percentage of material (PD) falling below the design thickness associated with Q_L (lower limit).

d. Reduction in Payment. The Department will determine the reduction in payment based on the quantity of the surface course multiplied by the percent reduction in payment from Table 401.03.07-5.

Table 401.03.07-5 Reduction in Payment for Nonconformance to Requirements for Total Thickness

Percent Defective	Percent Reduction
0 to 25.0	0
25.1 to 30.0	2
30.1 to 35.0	5
35.1 to 40.0	10
40.1 to 45.0	20
Over 45.0	Remove & Replace

e. **Retest.** If the initial series of 5 cores produces a percent defective value of PD ≥ 30, the Contractor may elect to take an additional set of 5 cores at random locations chosen by the RE. Notify the RE within 15 days of receipt of the initial core results to take the additional cores. If the RE is not notified within the 15 days, the Laboratory will use the initial core results to determine the reduction in payment for nonconformance requirements. If the additional cores are taken, the ME will recalculate the reduction in payment for nonconformance requirements using the combined results from the 10 cores.

f. **Removal and Replacement.** If the lot PD ≥ 45, remove and replace, or mill and overlay, the lot. The replacement work is subject to the same requirements as the initial work.

2. Surface Course Thickness. The Laboratory will evaluate the surface course solely to determine whether a remove- and-replace or an overlay condition exists, not for pay adjustment. The Laboratory will calculate the percent defective (PD) as the percentage of the lot that is less than the allowable thickness for the nominal maximum aggregate used in the surface course. The Laboratory will accept pavement lots with PD ≤ 30 and will reject pavement lots with PD > 30.

The Laboratory will base surface thickness acceptance on the percentage of the lot estimated to fall below the allowable thickness as follows:

a. **Sample Mean (X) and Standard Deviation (S) of the N Test Results (X1, X2,..., XN).** Calculate using the formula as specified in 401.03.03.I.1.

b. Quality Index (Q).

$Q_L = (\mathbf{X} - T_{all})/S$, where T_{all} is the minimum allowable thickness from Table 401.03.07-6.

Table 401.03.07-6 Surface Course Thickness Requirements

HMA Mix Design Size Designation	Minimum Allowable Compacted Lift Thickness (T_{all})
4.75 MM	0.50 inch
9.5 MM	1.00 inch
12.5 MM	1.25 inches
19 MM	2.00 inches

c. **Percent Defective.** Using NJDOT ST - Statistical Tables (NJDOT Standard Specs for Roads and Bridges 2019-NJDOT TEST METHODS) for the appropriate sample size, determine the percentage of material (PD) falling below the allowable thickness associated with Q_L (lower limit).

d. **Retest.** If the initial series of 5 cores produces a percent defective value of PD > 30, the Contractor may take an additional 5 cores at random locations determined by the Laboratory. Notify the RE within 15 days of receipt of the initial core results to take the additional cores. If the RE is not notified within the 15 days, the Laboratory will use the initial core results to determine the PPA. When the additional cores are taken, the Laboratory will recalculate the reduction in payment for nonconformance requirements using the combined results from the 10 cores to obtain the total PD.

e. **Removal and Replacement.** If the surface course fails to meet the acceptance requirement with a PD ≤ 45, the Department will require removal and replacement of the lot. The replacement work is subject to the same requirements as the initial work.

8. For paving over rubblized concrete, use C >286 to determine target IRI, then multiply T with 1.05 if total HMA after proposed treatment is less than 8-inch thick.
9 Paving in one lift with no corrective work such as milling, grinding or pre-levelling of at least 25 percent of surface area of existing pavement is one operation.

b. Corrective Action. The Department may require corrective action or assess the maximum negative pay adjustment as computed in Table 401.03.07-7, if the average IRI after testing is performed of NHS or NJDOT jurisdiction roadway is greater than 170 inches per mile, or average IRI local roadway is greater than T+80 or 170 whichever is higher. If the Department requires corrective action submit a plan for corrective action. If the plan for corrective action is approved and the lot is corrected, the Department will retest and evaluate the corrected area as a new lot that must meet the same requirements as the initial work. If the plan for corrective action is not approved, the Department may require removal and replacement. The replacement work is subject to the same requirements as the initial work.

401.04 Measurement and Payment

THE ENTIRE SECTION IS CHANGED TO:

The Department will not measure any item in this section. Separate Payment will not be made for Hot Mix Asphalt Courses or any item in this section.

DIVISION 600 – MISCELLANEOUS CONSTRUCTION

SECTION 601 PIPE

601.04 Measurement And Payment

THE ENTIRE SECTION IS CHANGED TO:

The Department will not measure Pipe. Separate Payment will not be made for Pipe or any other item in this section.

SECTION 606 SIDEWALKS, DRIVEWAYS, AND ISLANDS

606.03.02 Concrete Sidewalks, Driveways, and Islands

G. FINISHING CONCRETE

THE FOLLOWING IS ADDED:

Exposed aggregate sidewalk shall be finished to match the existing texture, including aggregate size, shape and type, and color of the existing exposed aggregate sidewalk. Joints shall match existing.

606.04 Measurement And Payment

THE ENTIRE SECTION IS CHANGED TO:

The Department will not measure Sidewalk, Driveways and Islands. Separate Payment will not be made for Sidewalk, Driveways and Islands or any other item in this section.

SECTION 607 – CURB

THE HEADING OF THIS SECTION IS CHANGED TO:

SECTION 607 – CURBS AND GUTTERS

607.01 DESCRIPTION

THE ENTIRE SECTION IS CHANGED TO:

THIS SECTION DESCRIBES THE REQUIREMENTS FOR CONSTRUCTING CONCRETE CURB CONCRETE HEADER CURB, GRANITE CURB, HMA CURB, CONCRETE GUTTER AND CONCRETE ROCKER GUTTER, FOR RESETTING GRANITE CURB AND FOR CUTTING CONCRETE VERTICAL CURB.

607.02.01 Materials
THE FOLLOWING IS ADDED:

Epoxy Waterproofing.....912.02.02

607.02.02 Equipment
THE FOLLOWING IS ADDED:

Concrete Vertical Curb Saw.....1008.07

607.03.02 CONCRETE VERTICAL CURB AND CONCRETE SLOPING CURB
THE HEADING IS CHANGED TO:

607.03.02 CONCRETE VERTICAL CURB, CONCRETE GUTTER, CONCRETE HEADER CURB, CONCRETE ROCKER GUTTER AND CONCRETE SLOPING CURB

THE FOLLOWING SUBPART IS ADDED:

607.03.08 Sawcut Vertical Curb

The RE will determine if the existing concrete vertical curb is suitable for sawcutting. Construct cast in place curb as specified in 607.03.02 if the existing curb exhibits visible cracking or deterioration or both.

Provide a concrete vertical curb saw as specified in 1008.07. Construct erosion control measures as specified in 158.03.02. Set the concrete vertical curb saw height to the desired vertical curb face height. Sawcut the vertical curb to within ±1/2 inch of the desired curb face dimension. Sawcut grooves as specified in 507.03.02.L to transition height differentials.

Finish the sawcut concrete vertical curb as specified in 607.03.01.E. Seal sawcut concrete with epoxy waterproofing as specified in 504.03.03. Prepare sawcut surface of concrete vertical curb according to manufacturer's directions before applying epoxy waterproofing.

Dispose of cut material as specified in 201.03.01.H.

THE ENTIRE SECTION IS CHANGED TO:

The Department will not measure curbs and gutters. Separate Payment will not be made for curbs and gutters or any other item in this section.

SECTION 610 – TRAFFIC STRIPES, TRAFFIC MARKINGS, AND RUMBLE STRIPS

6610.04 MEASUREMENT AND PAYMENT

THE ENTIRE SECTION IS CHANGED TO:

The Department will not measure Traffic Stripes, Traffic Marking and Rumble Strips. Separate Payment will not be made for Traffic Stripes, Traffic Marking and Rumble Strips or any other item in this section.

DIVISION 650 – UTILITIES

SECTION 651 – WATER

651.04 MEASUREMENT AND PAYMENT
THE ENTIRE SECTION IS CHANGED TO:

SEPARATE PAYMENT WILL NOT BE MADE FOR ANY WORK CONTAINED IN THIS SECTION.

SECTION 652 – SANITARY SEWERS

652.04 MEASUREMENT AND PAYMENT

THE ENTIRE SECTIONIS CHANGED TO:

SEPARATE PAYMENT WILL NOT BE MADE FOR ANY WORK CONTAINED IN THIS SECTION.

SECTION 653 – GAS

653.04 MEASUREMENT AND PAYMENT

THE ENTIRE SECTION IS CHANGED TO:

SEPARATE PAYMENT WILL NOT BE MADE FOR ANY WORK CONTAINED IN THIS SECTION

DIVISION 800 – LANDSCAPING

SECTION 808 – SODDING

808.03.01 Placing Sod

THE FIRST SENTENCE IS CHANGED TO:
Before placing sod, place 5 inches of topsoil as specified in 804.03.01.

808.04 MEASUREMENT AND PAYMENT
THE ENTIRE SECTION IS CHANGED TO:

SEPARATE PAYMENT WILL NOT BE MADE FOR SODDING.

DIVISION 900 – MATERIALS

SECTION 902 – ASPHALT

902.01.01 Asphalt Binder

THE FIRST TWO PARAGRAPHS ARE CHANGED TO:

Use an asphalt binder that is storage-stable and conforms to AASHTO M 332. Include compliance with the elastic response requirement in Figure 1 of AASHTO R 92, if applicable.

902.02.01 Mix Designations

PART (4) IS CHANGED TO:

4. **"E"** The fourth field in the Item description designates the high temperature designation of the performance-graded binder. Options are "64" for PG 64S-22 and "E" for PG 64E-22.

902.02.02 Composition of Mixtures

The following is added after the first sentence of the fourth paragraph:

HMA surface course may contain up to a maximum of 20 percent, by weight of RAP on public highway or local road projects and may contain up to a maximum of 35 percent, by weight of RAP on a local road project on a low volume road that does not receive State funds, as defined in NJSA 27:2-8.1.

The following is added after the first sentence of the fifth paragraph:

HMA base or intermediate course may contain up to a maximum of 35 percent, by weight of RAP on public highway or local road projects and may contain up to a maximum of 50 percent, by weight of RAP on a local road project on a low volume road that does not receive State funds, as defined in NJSA 40A:11-13a.

902.02.03 Mix Design

THE FOLLOWING IS ADDED TO THE FIRST PARAGRAPH:

Unless otherwise approved by the engineer, only one source of supply for hot mix asphalt surface course may be used on the project.

A General Acceptance Requirements.

THE SECOND PARAGRAPH OF SECTION (A) IS CHANGED TO:

For PG 64S-22, ensure that the temperature of the mixture at discharge from the plant or surge and storage bins is at least 290 °F when the ambient temperature is less than 50 °F or is at least 275 °F when the ambient temperature is greater than or equal to 50 °F. For PG 64E-22, ensure that the temperature of the mixture at discharge from the plant or surge and storage bins is at least 10 °F above the manufacturer's recommended laydown temperature. For mixes produced using a WMA additive or process, ensure that the temperature of the mixture at discharge from the plant or surge and storage bins is at least 10 °F above the WMA manufacturer's recommended laydown temperature.

902.02.04 Sampling and Testing

THE FOLLOWING SUBSECTION IS ADDED:

E. Acceptance of HMA. The Department may accept the HMA as specified in 902.02.04.A through 902.02.04.E by employing staff or an independent testing agency at the HMA plant during production. The inspector who performs the quality assurance sampling shall be certified by the Society of Asphalt Technologists of New Jersey as an Asphalt Plant Technologist, Level 2. Form "DS-8 HMA Testing Summary Report – State Aid" provided on the Local Aid Website must be utilized by the Laboratory to report their findings to the RE.

Alternatively, the Department may accept the HMA by Certification of Compliance according to 106.07.

902.05 STONE MATRIX ASPHALT (SMA)

902.05.01 Composition of Mixture

THE FIFTH PARAGRAPH IS CHANGED TO:

For fine aggregate, use 100 percent manufactured stone sand conforming to 901.05.02. Ensure that the combined fine aggregate of 100 percent manufactured stone sand in the mixture conforms to the requirements in Table 902.02.02-2.

902.05.02 Mix Design

TABLE 902.05.02-1 AND TABLE 902.05.02-2 ARE CHANGED TO:

Table 902.05.02-1 SMA Specification Band (% Passing) Nominal-Maximum Aggregate Size

Production Control Tolerances from JMF1	Sieve Size	19 mm % Passing	12.5 mm % Passing	9.5 mm % Passing
0%	1"	100	100	100
±3%	3/4"	90 – 100	100	100
±5%	1/2"	50 – 88	90 – 100	100
±5%	3/8"	25 – 60	50 – 80	70 – 95
±6%	No. 4	20 – 28	20 – 35	30 – 50
±3%	No. 8	16 – 24	16 – 24	20 – 30
±4%	No. 16	–	–	0 – 21
±3%	No. 30	–	–	0 – 18
±3%	No. 50	–	–	0 – 15
±2%	No. 200	7.0 – 11.0	7.0 – 11.0	7.0 – 12.0
–	Coarse Aggregate Fraction	Portion Retained on No. 4 Sieve	Portion retained on No. 4 Sieve	Portion retained on No. 8 Sieve

1. Production tolerances are for the approved JMF and may not fall outside of the wide band gradation limits.

Table 902.05.02-2 SMA Mixtures Volumetrics for Design and Plant Production		
Property	**Production Control Tolerances**	**Requirement**
Air Voids	±1%	3.5%
Voids in Mineral Aggregate (VMA)	–	17.0% minimum
VCAmix	–	Less than VCA_{DRC}
Draindown @ production temperature[1]	–	0.30% maximum
Asphalt Binder Content (AASHTO T 308)[2]	±0.40%	6% minimum[3]
Tensile Strength Ratio (AASHTO T 283)	–	80% minimum

1. For design, conduct draindown test at anticipated mixing temperature and 15°F higher. Ensure draindown test meets requirement at both temperatures. For production, conduct draindown test at 15°F higher than anticipated mixing temperature.
2. Asphalt binder content may not be lower than the minimum after the production tolerance is applied.
3. Aggregate blends with a Gsb value of 2.90 and higher may produce the mix with a minimum asphalt content of 5.8% with ME approval.

902.05.03 Sampling and Testing

THE ENTIRE SUBSECTION IS CHANGED TO:

A. General Acceptance Requirements. Ensure that the mix meets the requirements as specified in 902.02.04.A.

B. Sampling. The ME will take a random sample from each 700 tons of production for volumetric acceptance testing and to verify composition. The ME will perform sampling according to AASHTO T 168, NJDOT B-2, or ASTM D 3665. During production at the plant, a sample of asphalt binder will be taken once every 3,500 tons or as directed by the ME.

C. Quality Control Testing. Perform quality control testing as specified in 902.02.04.C.

For each acceptance test, perform testing for draindown according to AASHTO T 305 at 15°F above the mixing temperature.

Perform bulk specific gravity of coarse aggregates (G_{CA}) and dry-rodded voids in coarse aggregate VCA_{DRC} testing according to AASHTO R 46 by sampling and drying aggregates according to AASHTO R 90 and AASHTO T 255, respectively. The ME shall ensure that the G_{CA} and VCA_{DRC} of the aggregate blend has been determined within 7 days of the start of production. Stop production and conduct VCA_{DRC} test immediately when there are major changes to aggregate blend percentages. When performing the VCA_{DRC} test during production, use the G_{CA} value that was determined prior to production. The ME may request additional VCA_{DRC} tests to be conducted with or without requiring a new G_{CA} test to be performed at any time.

D. Acceptance Testing and Requirements. The ME will determine volumetric properties at 75 gyrations for acceptance from samples taken, compacted, and tested at the HMA plant according to AASHTO T 312. The ME will determine bulk specific gravity of the compacted sample according to AASHTO T 166. The ME will use the QC maximum specific gravity test result in calculating the volumetric properties of the SMA. The ME will determine VCA_{mix} according to AASHTO R 46.

If the acceptance sample is outside of the control tolerances for the No. 4 sieve in Table 902.05.02-1 or VCA_{mix} is greater than VCA_{DRC}, immediately take a quality control sample for testing. If the quality control sample is outside of the control tolerances for the No. 4 sieve in Table 902.05.02-1 or VCA_{mix} is greater than VCA_{DRC}, immediately stop production and shipping.

If the test results other than the No. 4 sieve or VCA_{DRC} are outside of the production control tolerances specified in Table 902.05.02-1 or Table 902.05.02-2 for an acceptance sample, immediately run a quality control sample. If the quality control sample is also outside of the control tolerances in Table 902.05.02-1 or Table 902.05.02-2, determine if a plant adjustment is needed and take corrective action to bring the mix into compliance. Take an additional quality control sample immediately after completing the corrective action to ensure that the mix is within tolerances. If the mix is within tolerance based on the quality control sample results, then the ME will immediately take an acceptance sample to test and verify that the composition, air voids, draindown, VCA_{mix}, and VMA meet the production control tolerances specified in Table 902.05.02-1 and Table 902.05.02-2. If 2 consecutive acceptance or quality control

samples are outside the tolerances specified in Table 902.05.02-1 or Table 902.05.02-2, immediately stop production and shipping.

After a production stop, obtain ME approval of a plant correction plan before resuming production. Upon restarting production, do not transport mixture to the Project Limits before the results of a quality control sample from the mixture indicate that the mixture meets JMF tolerances and ME approval.

902.06.01 Composition

THE SECOND PARAGRAPH IS CHANGED TO:

The mixture shall consist of asphalt binder and aggregate and may contain a WMA additive. Use asphalt binder that is PG 64S-22 as specified in 902.01.01. Use aggregate that conforms to 901.05.01 or 901.05.02 and the gradation requirements specified in Table 902.06.01-1.

902.07.02 Asphalt-Rubber Binder

PART (2) SUBSECTION (A) IS CHANGED TO:

2. Asphalt Binder.

a. Use asphalt binder that conforms to AASHTO M 332, Table 1; PG 64S-22, PG 58-28 or an approved blend of both grades. The asphalt binder producer is required to provide the asphalt binder quality control plan annually to the ME for approval. Ensure that the quality control plan conforms to AASHTO R 26. Submit to the ME a certification of compliance, as specified in 106.07, for the asphalt binder. The ME will perform quality assurance sampling and testing of each asphalt binder lot as defined in the approved quality control plan.

902.13.01 Mix Designations

PART (4) IS CHANGED TO:

4. "E" The fourth field in the Item description designates the high temperature designation of the performance-graded binder. Options are "64" for PG 64S-22 and "E" for PG 64E-22.

902.13.03 Mix Design

TABLE 902.13.03-2 CHANGED TO:

Table 902.13.03-2 Performance Testing Requirements for HMA HIGH RAP Design

Test	Requirement			
	Surface Course		Intermediate and Base Course	
	PG 64S-22	PG 64E-22	PG 64S-22	PG 64E-22
APA @ 8,000 loading cycles (AASHTO T 340)	≤ 7 mm	≤ 4 mm	≤ 7 mm	≤ 4 mm
Overlay Tester (NJDOT B-10)	≥ 200 cycles	≥ 275 cycles	≥ 100 cycles	≥ 150 cycles

902.13.04 Sampling and Testing

TABLE 902.13.04-2 CHANGED TO:

Table 902.13.04-2 Surface Course Performance Testing Pay Adjustments for HMA HIGH RAP			
	Surface Course		PPA
	PG 64S-22	PG 64E-22	
APA @ 8,000 loading cycles, mm (AASHTO T 340)	t ≥ 7	t ≤ 4	0
	7 < t ≤ 10	4 < t ≤ 7	PG 64S-22: -50(t-7)/3 PG 64E-22: -50(t-4)/3
	t > 10	t > 7	-100 or Remove & Replace
Overlay Tester, cycles (NJDOT B-10)	t ≥ 200	t ≥ 275	0
	200 > t ≥ 150	275 > t ≥ 200	Surface PG 64S-22: -(200-t) Surface PG 64E-22: -(275-t)/1.5
	t < 150	t < 200	-100 or Remove & Replace

TABLE 902.13.04-3 CHANGED TO:

Table 902.13.04-3 Intermediate and Base Course Performance Testing Pay Adjustments for HMA HIGH RAP			
	Intermediate and Base Course		PPA
	PG 64S-22	PG 64E-22	
APA @ 8,000 loading cycles, mm (AASHTO T 340)	t ≤ 7	t ≤ 4	0
	7 < t ≤ 10	4 < t ≤ 7	PG 64S-22: -50(t-7)/3 PG 64E-22: -50(t-4)/3
	t > 10	t > 7	-100 or Remove & Replace
Overlay Tester, cycles (NJDOT B-10)	t ≥ 100	t ≥ 150	0
	100 > t ≥ 75	150 > t ≥ 110	Intermediate PG 64S-22: -(2t-200) Intermediate PG 64E-22: -1.25(150-t)
	t < 75	t < 110	-100 or Remove & Replace

SECTION 903 – CONCRETE

903.01 CEMENT

THE ENTIRE SUBSECTION TEXT IS CHANGED TO:

Use cement, listed on the QPL, that is either portland cement or blended hydraulic cement and conforms to the following:

Portland Cement, Type I, II, and Type III..... ASTM C 150
Blended Hydraulic Cement, Type IS, IP, and IL ..... ASTM C 595

Only use Type III portland cement for Class V concrete, prestressed Items, and precast Items.

Use portland cement pre-blended with a maximum of 25 percent fly ash, by weight, or a maximum of 5 percent silica fume by weight, or with a maximum of 50 percent slag by weight for blended hydraulic cement Type IS or IP. Use portland cement pre-blended with a minimum of 5 percent limestone content and a maximum of 15 percent limestone content by weight for blended hydraulic cement Type IL. Ensure that a scaling test according to ASTM C 672 is completed on the mix design if more than 30 percent slag is used and that the concrete has a visual rating less than 3 after 50 cycles.

Do not add additional mineral admixtures to blended hydraulic cements Type IS or IP at the concrete plant unless approved by the ME. The use of additional mineral admixtures in blended hydraulic cement Type IL at the concrete plant is permitted if the mineral admixture is listed on the QPL

Do not mix different brands of cement, the same brand of cement from different mills, or different types of cement.

Provide suitable means for storing and protecting the cement against dampness. The ME will reject cement that has become partially set or that contains lumps of caked cement. Ensure that the temperature of the cement at the time of delivery to the mixer does not exceed 160 °F.

SECTION 909 – DRAINAGE

909.02.02 HDPE Pipe

THE SUBPART HEADING IS CHANGED TO:

909.02.02 HDPE Pipe and Polypropylene (PP) Pipe
THE ENTIRE SUBPART IS CHANGED TO:

Use corrugated HDPE drainage pipe that conforms to AASHTO M 294 and is Type S (smooth interior with annular corrugations) with gasketed silt-tight joints.

Use corrugated polypropylene (PP) drainage pipe that conforms to AASHTO M 330 and is Type S (smooth interior with annular corrugations) with gasketed silt-tight joints.

Use HDPE and polypropylene (PP) pipe from a manufacturer who is an AASHTO NTPEP (National Transportation Product Evaluation Program) certified manufacturer. For a list of NTPEP certified manufacturers, see the following webpage: https://data.ntpep.org/.

Submit a certification of compliance, as specified in 106.07, for HDPE and polypropylene (PP) pipe.

SECTION 911 – SIGNS, SIGN SUPPORTS, AND DELINEATORS

911.01.01 Materials

B. Retroreflective Sheeting.
TABLE 911.01.01-2 IS CHANGED TO:

Table 911.01.01-2 Allowable Sign Sheeting Types

Sign Type	Test Method	Type
Regulatory and Warning Signs	ASTM D 4956	Type III, Type VIII, Type IX or Type XI[1]
Guide Signs Mounted on Steel "U" Posts	ASTM D 4956	Type III, Type VIII, Type IX or Type XI
Guide Signs Mounted on Overhead Sign Structures, Breakaway Sign Supports, or Non-breakaway Sign Supports	ASTM D 4956	Type VIII, Type IX or Type XI[2]

1. Ground-mounted signs with white background shall be ASTM Type IX.
2. Do not use ASTM Type XI sheeting with any existing sign lighting improvement or signs that are lit.

911.01.02 Fabrication

A. Sign Panels.
THE SECOND PARAGRAPH IN PART A IS CHANGED TO:

Fabricate flat sheet signs from a single piece of sheet aluminum without joints, using the thicknesses specified in Table 911.01.02-1. Drill or punch 3/8 inch diameter holes in the sign blank for attachment to sign supports. Locate holes according to the 2004 Edition of Standard Highway Signs and Markings Book. If the panel is larger than 5 feet in any dimension, reinforce the panel with z-bars.

C. Legends and Borders.
THE FIRST PARAGRAPH IN PART C IS CHANGED TO:

The legend for each sign consists of letters, numerals, shields, and other symbols. Use Series E Modified 2000 lettering that conforms to the 2004 Edition of Standard Highway Signs and Markings Book. Ensure that the lettering is aligned, spaced, and sized according to 2004 Edition of Standard Highway Signs and Markings Book, its 2012 Supplement, and the working drawings. Apply the legend and borders using the following methods:

911.01.04 Acceptance Inspection

THE FIRST PARAGRAPH IS CHANGED TO:

Notify the ME at least 3 days before shipping to the Project so that arrangements for inspection can be made. The ME will reject signs not fabricated according to the 2004 Edition of Standard Highway Signs and Markings Book, its 2012 Supplement, and the Plans. The ME will ensure that finished signs are clear and legible without smudging, blisters, delamination, loose edges, or other blemishes. The ME will also ensure that the colors have a consistent chromaticity across all signs of the same color.

SECTION 912 – PAINTS, COATINGS, TRAFFIC STRIPES, AND TRAFFIC MARKINGS

912.04.02 Removable Pavement Marking Tape

A. Temporary Pavement Tape.

THE FOURTH PARAGRAPH IN PART A IS CHANGED TO:

Provide a certification of compliance, as specified in 106.07, for temporary pavement tape.

B. Removable Black Line Masking Tape.

THE THIRD PARAGRAPH IN PART B IS CHANGED TO:

Provide a certification of compliance, as specified in 106.07, for removable black masking tape.

SECTION 913 – GUIDE RAIL, FENCE, RAILING, AND BOX BEAM

913.04 BOX BEAM FOR CONSTRUCTION BARRIER CURB
THE FIRST PARAGRAPH IS CHANGED TO:

Ensure that the box beam is made of cold-formed welded and seamless structural tubing. Ensure that the box beam conforms to ASTM A 500, Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes, Grade C.

SECTION 914 – JOINT MATERIALS

914.04.03 Modular

THE SUBPART IS RENAMED TO:

914.04.03 Modular Expansion Joint Assemblies

B. Materials.
PART 1 IS CHANGED TO:

1. Use structural steel conforming to the requirements of AASHTO M 270M / M 270 (ASTM A 709 / A 709M), Grade 50, or Grade 50W with Zone 2 CVN requirements for centerbeams, supporting beams, and yokes. Use structural steel AASHTO M 270 M / M (ASTM A 709 / A 709M) Grade 36, Grade 50, or Grade 50W for other steel components. Do not use aluminum components.

PART 3 IS CHANGED TO:

3. Use PTFE that is 100 percent virgin material, woven PTFE fabric, or dimpled PTFE conforming to the material requirements in Section 14 of the AASHTO LRFD Bridge Design Specifications, and Section 19 of AASHTO LRFD Bridge Construction Specifications.

THE 2ND PARAGRAPH IS CHANGED TO:

Perform prequalification tests, Open Movement and Vibration (OMV) testing and Seal Push-Out (SPO) testing, according to AASHTO LRFD Construction Specifications Section 19/A19 and provide testing report. Certify that the tested modular expansion joint assembly has passed the prequalification tests required in AASHTO LRFD Construction Specifications.

THE FOLLOWING IS ADDED AT THE END:

Provide certification that materials of bearings, springs, and equidistant devices used in the project product are identical to those used in the prequalification tests in material composition and formulation, and conform to the same manufacturing process, fabrication procedure, and configuration as those used in the prequalification tests. In addition, certify that these materials and fabrication procedures are as per working drawing plans and specifications provided by the manufacturer at the time of approval.

SECTION 915 – TIMBER AND TIMBER TREATMENT

915.04 DIMENSION LUMBER, TIMBER, AND DECKING FOR STRUCTURES

THE FIRST PARAGRAPH IS CHANGED TO:

Use dimension lumber, timber, glued-laminated timber, and decking for structures that conform to AASHTO M 168 with the following modifications:

1. Manufacture dimension lumber and timber from Southern pine or Douglas fir of structural grade that conforms to the grading rules of the Southern Pine Inspection Bureau or the Western Lumber Inspection Bureau. Ensure that the grading is performed by an agency approved by the Board of Review of the American Lumber Standards Committee. Use Southern pine that is designated and graded as No. 2 if 2 to 4 inches nominal thickness and as No. 1 if 5 inches nominal thickness or thicker. Use Douglas fir that is designated and graded as Dense No. 1.
2. For decking subjected to vehicular traffic, use timber that is graded as No. 1 Dense Southern Pine or Douglas-fir lumber and timbers . Dress timber for bridge decking square edged S4S.
3. For decking used exclusively by pedestrians, use No. 1 grade Southern Pine or Douglas-fir lumber and timbers that are dressed square edged S4S.
4. Treat timber as specified in 915.05, except do not preserve timber railing systems and decking used by pedestrians with creosote. In addition, do not preserve timber decking to be covered with an HMA overlay with creosote.

915.05 TIMBER TREATMENT

THE ENTIRE SUBSECTION IS CHANGED TO:

Treat wood species according to AASHTO M 133 and AWPA Standards U1-20 and T1-20, including those as summarized in Table 915.05-1, Table 915.05-2, and Table 915.05-3.

Table 915.05-1 Treatment for Sawn Timber Posts

Type of Wood	Location/Environment	AASHTO Treatments	AWPA Standard Reference for Minimum Retention Level
Southern Pine	Soil or Fresh Water	CCA or Pentachlorophenol	UC4A
Douglas Fir	Soil or Fresh Water	ACZA	UC4A

Table 915.05-2 Treatment for Round Timber Piles			
Type of Wood	**Location/Environment**	**AASHTO Treatments**	**AWPA Standard Reference for Minimum Retention Level**
Southern Pine	Soil or Fresh Water	CCA	UC4C
Southern Pine	Marine	CCA	UC5B
Douglas Fir	Soil or Fresh Water	ACZA	UC4C
Douglas Fir	Marine	ACZA	UC5B

Table 915.05-3 Treatment for Timber Sheet Piling and Timber for Structures			
Type of Wood	**Location/Environment**	**AASHTO Treatments**	**AWPA Standard Reference for Minimum Retention Level**
Southern Pine	Soil or Fresh Water	CCA or Pentachlorophenol	UC4B
Southern Pine	Marine	CCA	UC5B
Douglas Fir	Soil or Fresh Water	ACZA	UC4B
Douglas Fir	Marine	ACZA	UC5B

Notify the ME at least 14 days before treating timber. If directed by the ME, perform an assay to determine the retention of preservative according to AASHTO M 133 and referenced AWPA standards. Submit certification of compliance as specified in 106.07. Attach the assay report to the certification.

The use of uncoated pressure-treated timber using the above timber treatments, as specified in Table 915.05-1, Table 915.05-2, and Table 915.05-3, may not be permitted in areas containing shellfish or submerged aquatic vegetation, or in other environmental sensitive areas. Alternative materials, such as plastic, natural cedar or other untreated wood, polymer coated pressure-treated wood, concrete or other inert products, may be required by regulatory agencies. Prior to using treated timber products, contact the NJDOT Bureau of Landscape Architecture and Environmental Solutions or the Division of Environmental Resources, as appropriate.

All lumber and timber, including those specified in Table 915.05-1, Table 915.05-2, and Table 915.05-3, must be pressure treated according to current AWPA or AASHTO M 133 standards. Preservatives are subject to EPA Guidelines 2004 with restricted use of CCA preservatives.

SECTION 917 – LANDSCAPING MATERIALS

917.08 PLANT MATERIALS

H. Inspection.

Notify the RE at least ____ (hours or days) in advance of delivery to the Project Limits for installation.

SECTION 919 – MISCELLANEOUS

919.05 GEOMEMBRANE LINER

TABLE 919.05-1 IS CHANGED TO:

Table 919.05-1 Requirements for HDPE Resin		
Property	**Test Method**	**Requirements**
Specific Gravity (Resin & Carbon Black)	ASTM D 792	> 0.940
Melt Index	ASTM D 1238	< 0.4 g/10 min
Carbon Black Content	ASTM D 1603	2 – 3 %

DIVISION 1000 – EQUIPMENT

SECTION 1001 – TRAFFIC CONTROL EQUIPMENT

1001.01 FLASHING ARROW BOARD
SUBSECTION HEADING AND THE ENTIRE TEXT ARE CHANGED TO:

1001.01 ARROW BOARD

Provide either Type A or Type C or both types of arrow boards. Ensure the arrow board elements conform to the MUTCD and the following requirements:

1. Non-reflective, black boards equipped with battery-operated amber lights.
2. A minimum peak luminous intensity of 8,800 candelas and equipped with photocells that will automatically reduce the luminous intensity to 1,500 candelas when the ambient light level drops to 5 foot-candles.
3. A light on the rear face of the board to indicate that the lights are operating.
4. Solid state controls with polarity and surge protection.
5. Panel operation controls mounted in a lockable enclosure.

Ensure the arrow boards are equipped with a diesel charged battery system. Do not use gasoline powered systems. With RE approval, the Contractor may use the arrow boards equipped with solar charged battery systems in non-moving operations. The Department may require a solar charged battery system in noise sensitive areas.

Securely mount arrow boards on a manufacturer-approved 2 wheeled towing trailer.

1001.03 TRAFFIC CONTROL TRUCK WITH MOUNTED CRASH CUSHIONS

THE ENTIRE SUBSECTION IS CHANGED TO:

Provide a truck affixed with a bed-mounted type C arrow board, as specified in 1001.01, and a rear mounted crash cushion. Ensure the weight of the truck with the type C arrow board and the rear mounted crash cushion is minimum total weight of 10 tons. The Contractor may use ballast to meet the weight requirement. When using ballast, ensure that it is securely fastened to the truck. Provide crash cushions that conforms to the following requirements:

1. Meets crash-worthiness requirements as specified in 159.03.02.
2. Designed to be attached to the rear of a truck.
3. Equipped with a 90 degree hydraulic tilt system to raise and lower the crash cushion. The tilt system shall have a locking mechanism to secure the crash cushion when in the raised position.
4. If equipped with energy absorbing modules, ensure that they are painted yellow.
5. Displays alternating 6 inch wide black and yellow bands, composed of Type III-retroreflective sheeting, as specified in ASTM D 4956, in an inverted “V” chevron pattern on the surface of the rear module that faces traffic. When in the raised position, ensure that the surface of the rear facing module also displays the chevron pattern.
6. Equipped with standard trailer lighting systems, including brake lights, taillights, and turn signals that are visible in the raised and lowered positions.

SECTION 1003 – HMA SITE EQUIPMENT

1003.01 MATERIALS TRANSFER VEHICLE (MTV)

THE FOLLOWING IS ADDED AFTER THE LAST PARAGRAPH:

Ensure the MTVs Gross Weight and maximum speed limit do not exceed the load restrictions as shown in 105.09 Special Provisions.

SECTION 1008 – MISCELLANEOUS EQUIPMENT

THE FOLLOWING SUBSECTION IS ADDED:

1008.07 CONCRETE VERTICAL CURB SAW

Provide a power-driven vertical curb saw with horizontally-oriented blade capable of sawing to the required dimensions without causing uncontrolled cracking. Equip the vertical curb saw with water-cooled, circular, diamond-edge blades or abrasive wheels, and alignment guides. Ensure that the vertical curb saw is capable of immediately collecting the slurry produced from the operations. The Contractor may use a vertical curb saw that does not collect slurry if the RE approves an alternate slurry collection method.

When sawcutting grooves, use a multi-bladed saw with an adequate number of blades and alignment wheels.

Provide within the Project Limits spare saw blades and at least one standby saw that meets the above requirements.

SECTION 1009 – HMA PLANT EQUIPMENT

1009.01 HMA PLANT

A. Requirements for HMA Mixing Plants.

8. Safety.

THE THIRD PARAGRAPH IS CHANGED TO:

> When plant production occurs during night operations, provide permanently fixed lighting throughout the plant operations, plant laboratory, and truck scale areas to ensure a clear view of the operations. Also provide permanently mounted lighting at the sampling platforms to sufficiently illuminate the bed of the truck for inspection and sampling operations.

APPENDIX A



RECYCLED ASPHALT PAVEMENT AND ASPHALT MILLINGS (RAP) REUSE GUIDANCE

MARCH 2013
(VERSION 1.0)

RECYCLED ASPHALT PAVEMENT AND ASPHALT MILLINGS (RAP) REUSE GUIDANCE MARCH 2013

A. GENERAL INFORMATION

It is the policy of the New Jersey Department of Environmental Protection (Department or NJDEP) to encourage and promote the use of recycled asphalt pavement (RAP), including asphalt millings excavated from public highways and roads consistent with the provisions of N.J.A.C. 7:26 & 26A. The Department has determined that the allowed uses of RAP described in this guidance document are consistent with the provisions of N.J.A.C. 7:26 and N.J.A.C. 7:26A. This guidance document ("Guidance") is intended only as a guide to address the controlled use of recycled asphalt millings and does not replace any regulations in any context.

RAP may be recycled pursuant to existing regulations at N.J.A.C. 7:26A-1.4(a)1 for recycling directly into hot mix asphalt pavement without the Department's prior approval; reused directly for road construction without the Department's approval as outlined below; and, used for beneficial uses pursuant to N.J.A.C. 7:26-1.1(a)1 and 1.7(g) respectively without or with site-specific Department approval, as outlined below.

B. DEFINITION OF TERMS

Allowed Uses: Allowed Uses shall mean Commercial Allowed Uses, Transportation Allowed Uses and Other Allowed Uses pursuant to Paragraph C(4) of this Guidance.

Child Care Center: means such a facility as defined at N.J.S.A. 30:5B-13 et seq.

Clean Site: A site that contains soil or non-soil materials that meet the definition of "Clean fill" at N.J.A.C. 7:26E-1.8 and the Residential Direct Contact Soil Remediation Standards (RDCSRS) at N.JA.C. 7:26D.

Commercial Allowed Uses: Commercial Allowed Uses shall have the meaning set forth in Paragraph C(3) of this Guidance.

Cover Material: Soil or non-soil materials that meet the definition of "Clean fill" at N.J.A.C. 7:26E-1.8 and the Residential Direct Contact Soil Remediation Standards (RDCSRS) at N.J.A.C. 7:26D such as, but not limited to, recycled concrete, topsoil, unconsolidated sediment (sand, gravel, clay, silt, and the like), and rock obtained directly from a quarry. Cover Material does not include coal or other carbonaceous materials extracted from the earth.

Nonresidential: As used herein, the term "nonresidential" means for commercial, or industrial uses or other location of nonresidential use as defined at N.J.A.C. 7:26D-1.5 (definitions of "Nonresidential Direct Contact Soil Remediation Standard" and "Nonresidential Use").

Recycled Asphalt Pavement (RAP): Recycled asphalt pavement (RAP) shall mean asphalt millings (the material produced from the milling of roads before repaving) and pieces of asphaltic roadway pavement removed from the roadway surface or subbase, or from other

asphalt-paved surfaces such as parking lots. RAP does not include other Class B recyclable materials that contain recycled asphalt.

Residential: As used herein, the term "Residential" means a human residence, child care center, school, or other location of residential use as defined at N.J.A.C. 7:26D-1.5 (definitions of "Residential Direct Contact Soil Remediation Standard" and "Residential Use").

Transportation Allowed Use: Transportation Allowed Use shall have the meanings set forth in Paragraph C(2) of this Guidance.

C. ALLOWED USES

1. General Standards

a. Unless otherwise approved in advance in writing by the Department in accordance with applicable State law, to the extent that RAP is used in Transportation Allowed Uses, such use shall be in accordance with the following NJDOT 2007 Standard Specification for Road and Bridge Construction (or subsequent version): Section 203 -- Embankments for roadways, Subsection 203.03.01, which allows use of RAP in I-14 soil aggregate embankment that is at least two (2) feet above the water table.

b. A Transportation Allowed Use would be prohibited if site-specific engineered design requirements demonstrate unsuitable performance of the RAP.

c. Unless otherwise specified herein, all Allowed Uses of RAP shall be fully consistent with appropriate engineering design (including the volume of material).

d. RAP may be taken directly to and used by asphalt manufacturing plants for direct incorporation into hot mix asphalt or warm mix asphalt, in accordance with NJDOT standards, pursuant to the recycling exemption for such use at N.J.A.C. 7:26A-1.4(a)1.i and (b).

e. Any use of RAP under slabs of concrete at any site requires the filing of a Deed Notice identifying the location, quantity and amount of the RAP; installation, operation and maintenance of a complete vapor barrier; compliance with the Department's Vapor Intrusion Technical Guidance; compliance with all local building code and zoning and other requirements. This use of RAP is strictly limited to use under the slab. RAP at the site that cannot be consolidated to the area under the slab must be removed and managed as RAP in accordance with this Guidance or disposed as Solid Waste.

2. Transportation Allowed Uses (Nonresidential Sites)

a. Subject to the conditions set forth herein, RAP may be used in nonresidential roadway transportation and/or construction-related activities and under nonresidential building structure slabs that are unoccupied except for infrequent, short-term visits of employees or other persons (such as at salt storage or

transportation equipment storage buildings, hereinafter "Transportation Buildings"), without the Department's prior site- or project-specific approval ("Transportation Allowed Uses"). These uses are considered direct use pursuant to N.J.A.C. 7:26-1.1(a)1 and do not require authorization as a Beneficial Use Project by the Department pursuant to N.J.A.C. 7:26-1.7(g) when performed as outlined below.

b. Except as set forth in Paragraph E(8) of this Guidance, RAP may be used for roadway and parking area soil aggregate subbase material, if the RAP is placed directly beneath, and fully contained by a paved road surface of either hot mix asphalt or Portland cement concrete.

c. RAP may be used to construct or repave roadway or vehicle use areas, such as parking lots and pot-hole filling, if such application is performed when the material is sufficiently hot to make the asphalt sufficiently pliable and adhesive to bind the asphalt millings particles on application. Alternately, RAP may be thoroughly mixed with an asphalt emulsion to produce a cold mix. These applications of the RAP should be followed by immediate rolling to complete the integration of the milling pieces and particles into a bound surface that is similar in consistency and performance to a hot mix asphalt or warm mix asphalt paved surface, such as a road. Rolling the surface will permanently rebind the RAP particles into a slab to prevent erosion and will ensure a dense, flat paved surface suitable for vehicular use.

d. RAP may be used as surfacing materials if an appropriate binder is applied to bind the RAP. Liquid asphalt emulsion may be used to bind the RAP in surficial applications.

e. RAP may also be used for the following, subject to the requirements of Paragraph C(2)(d) to the extent that RAP is used as surficial material and subject to Paragraph C(1)(b), as applicable:

   (i.) Roadway edge stability and guard rail base material provided that the use complies with Paragraph C(2)(d) of this Guidance.;

   (ii.) Base material (such as NJDOT I-14) under impervious surfaces, such as footings, foundations and slabs of Transportation Buildings.;

   (iii.) Pipe, utility corridor bedding material above the seasonal, high ground water level covered with Cover Material, of a composition, characteristic and thickness that will prevent exposure of RAP at the surface. There shall be no visible RAP at the surface or at the perimeter of the application of Cover Material over RAP. The Cover Material layer shall be maintained to prevent RAP migration to the surface and perimeter.

   (iv.) Component of boulder/stacked concrete wall structure;

   (v.) Underpass abutment structures; and

(vi.) Stabilized wall structures, abutment fill, and retaining wall backfill material.

f. RAP may be covered with Cover Material, of a composition, characteristic and thickness that will prevent exposure of RAP at the surface. There shall be no visible RAP at the surface or at the perimeter of the application of Cover Material over RAP. The Cover Material layer shall be maintained to prevent RAP migration to the surface and perimeter.

3. **Industrial and Commercial Applications — Nonresidential uses only ("Commercial Allowed Uses")**

a. Building Foundations — except as set forth in Paragraph E(3), RAP may be used in subbase material placed under concrete slabs for nonresidential building structures in accordance with an appropriate engineering design and Paragraph C(1)(e) of this Guidance.

b. Other uses as approved by the Department per N.J.A.C. 7:26-1.7(g), such as at Clean Sites without prior construction, on a case-by-case basis and in accordance with an appropriate engineering design pursuant to Paragraphs E(3) and C(4) of this Guidance.

4. **Other Allowed Uses**

Other uses of RAP may be authorized pursuant to regulations at N.J.A.C. 7:26-1.7(g) for beneficial use of materials ("Other Allowed Uses"). Contact the Beneficial Use section of the Bureau of Landfill and Hazardous Waste Permitting, Solid and Hazardous Waste Management Program at (609) 984-6985 for more information on the authorization process for a Certificate of Authority to Operate a Beneficial Use Project for RAP beneficial use applications. An application form for a Certificate of Authority to Operate a Beneficial Use Project, along with other information concerning the regulation of beneficial use of materials in New Jersey, can be found within the internet web page for beneficial use at: http://www.state.nj.us/dep/dshw/rrtp/bud.htm .

D. STORAGE: RAP for Transportation Allowed Uses, Commercial Allowed Uses and Other Allowed Uses shall be stored in compliance with all applicable laws.

E. PROHIBITED USES

The following uses of RAP are prohibited, except as provided below:

1. As final surfacing material, unless the RAP is bound with asphalt emulsion, or paved with hot mix asphalt or Portland cement concrete;

2. In wetlands, flood fringe, floodways or buffers to these regulated areas, unless such use is in conjunction with the repair, maintenance, or replacement of an existing vehicular paved surface, roadway or parking lot, and is undertaken in accordance with the requirements of the Freshwater Wetlands Protection Act

(FWPA), Flood Hazard Area Control Act (FHACA), and the regulations promulgated pursuant to these statutes;

3. As fill material at any Clean Site, except as authorized by the Department in writing in advance on a site- or project-specific basis, or as outlined for specific instances in Section C above;

4. Use in the reclamation of quarries of unconsolidated materials (e.g., sand, gravel);

5. Use in the reclamation and restoration of bedrock quarries unless specifically approved in writing in advance by the Department and in accordance with all relevant permit and other regulatory requirements;

6. Use as fill material, except for uses as provided for by this guidance in accordance with State law.

7. Less than two (2) feet above the seasonal high water table at the site of placement.

8. Use as roadway subbase in projects that must meet NJDOT specifications.

F. ENVIRONMENTAL AND PUBLIC HAZARDS

The bitumen binder used in asphalt paving applications contains a relatively high concentration of a family of organic compounds that has the potential to pose human health and environmental concerns in certain circumstances, especially when asphalt material is ground into very small particles that easily blow off of or wash from the surface. These compounds, known as polycyclic aromatic hydrocarbons (PAHs) are present in RAP at higher levels than the criteria established by the NJDEP's Site Remediation Program guidance for general use in a loose fashion on land. RAP used alone without a paved top surface has the potential to significantly migrate from the roadway through the actions of water, wind, and physical displacement and possibly contaminate surrounding soils and/or surface water sediments. Traffic traveling on the unpaved RAP could generate dust containing the compounds referenced above and the dust would be a major migration route of the RAP to the surrounding environment.

G. VEHICLE REQUIREMENTS

Note that a NJDEP solid waste vehicle registration pursuant to N.J.A.C. 7:26-1 et seq. for vehicles hauling RAP is not required for the transport of RAP for uses meeting the conditions of Section C and D above, to NJDEP-approved recycling centers or for Department-approved beneficial uses. However, a NJDEP solid waste vehicle registration is required for vehicles hauling RAP if the RAP is being disposed of as solid waste pursuant to N.J.A.C. 7:26-1 et seq. either in or out of State.

H. COMPLIANCE WITH OTHER LAWS AND REQUIREMENTS

Nothing contained in this guidance document is intended or shall be construed to exempt any use of RAP from compliance with other applicable lawful State and federal requirements and as subject to N.J.S.A. 13:1E et seq. and shall not supersede any applicable statutes or regulations.

This guidance does not represent an authorization to use RAP without obtaining site or project-specific authorization as a Certificate of Authority to Operate a Beneficial Use Project pursuant to N.J.A.C. 7:26-1.7(g), except for the uses as indicated above in Section C.2. Failure to obtain proper Department approval as required by State law prior to using RAP, except for the uses indicated in Section C.2 above may subject the responsible party to enforcement action, including, but not limited to the assessment of penalties and responsibility for any necessary remediation. This guidance shall not affect the Department's ability to pursue ongoing enforcement actions regarding the use of RAP or initiate enforcement actions against entities for past uses of RAP that are not in conformance with the provisions of this guidance document or applicable regulations.

Should you have any questions regarding this guidance document, you may discuss your questions with a representative in the Technical Assistance unit of the Bureau of Landfill and Hazardous Waste Permitting at (609) 984¬6985 between the hours of 9:00 a.m. and 4:00 p.m.

APPENDIX B

New Public Works Building

101 North Benson Ave
Margate City, Atlantic County, New Jersey

Geotechnical Investigation Report
September 30, 2024

Prepared for:
Margate City
Municipal Building
9001 Winchester Avenue
Margate, NJ 08402

Submitted by:
K. Charles Westen, PE
NJ License No. 47013

K. Charles Westen
Signature

September 30, 2024
Date

Prepared by:
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RVE Project Number: 0116U200

RVE 1901 REMINGTON & VERNICK ENGINEERS

GEOTECNICAL INVESTIGATION REPORT

Table of Contents

Section	Page
Introduction	3
Site & Project Description	3
Subsurface Investigation	3
Laboratory Testing	4
Subsurface Conditions	4
Discussions & Recommendations	6
Foundations	10
Floor Slabs	11
Seismic	11
Limitations	12

Appendices:

Appendix A – Site Location Map/USGS Quadrangle
Appendix B – Soil Boring Location Plan
Appendix C – Soil Boring Logs
Appendix D – Normalized N-Values
Appendix E – Lab Results
Appendix F – Seismic Information

INTRODUCTION

Remington & Vernick Engineers (RVE) has prepared this report which presents the findings, conclusions, and recommendations of a geotechnical investigation conducted for the proposed New Public Works Facility in Margate, New Jersey. The proposed building will be located within the City Public Works yard located at 101 North Benson Avenue in Margate City, Atlantic County, New Jersey.

The purpose of the geotechnical investigation is to determine the subsurface conditions at the site and to provide recommendations, from a geotechnical engineering viewpoint, for the most suitable type of foundation, site preparation, earthwork operations, and other geotechnical considerations.

SITE & PROJECT DESCRIPTION

Presently, the proposed new public works building will be located in the northern end of the Benson Avenue public works yard. The proposed building is expected to be a two-story steel frame and masonry bearing wall structure, with a footprint of approximately 8,250 square feet. At the time of our geotechnical investigation, the proposed building site was being used as a parking area for the City's public works motor pool, including many emergency vehicles and associated equipment. Two prefabricated sheds are also within the proposed building footprint. Structure loads and final dimensions of the proposed building were not made available to us at the time of report preparation. It is expected that the building will be supported on a deep pile foundation system.

Presently the site is relatively flat and level. Final site grades are not known; however, the final site grades are not expected to change from those that currently exist at the site.

SUBSURFACE INVESTIGATION

A Standard Penetration Test (SPT) boring investigation for this project was performed on August 18 and 19, 2024. The investigation consisted of four (4) SPT test boring drilled by Boring Brothers Inc., utilizing the mud rotary method of drilling at a location selected by RVE. The soil borings, designated as B-1 through B-4 were drilled to a depth of 52 feet below existing grade. All drilling and soil sampling operations were supervised by RVE. The field logging of the soil samples was also performed by a representative of RVE.

Soil samples were recovered via a two-inch O.D. split-spoon sampler; driven by a hydraulically activated 140-pound hammer, free falling 30 inches (ASTM D 1586). The number of hammer blows required to advance the 24-inch spoon in 6-inch increments (four increments in all) were recorded. The number of blows required to penetrate the middle two increments (6 to 18 inches) is known as the Standard Penetration Resistance (N). Soil samples were obtained continuously in the upper 12 ft and at 5 ft intervals thereafter. Recovered soil samples were visually classified in the field using the Burmister Soil

Identification System and the Unified Soil Classification System. The results of the visual analyses were utilized to prepare the attached Soil Boring Logs. The locations of the test borings are shown on the attached boring location plan.

The results of the visual analyses were utilized to prepare the attached Test Boring Logs which are presented in Appendix C of this report, along with a Glossary of Terms and Definitions. The approximate location of the test borings, along with other pertinent site information, is shown on the Boring Location Plan, in Appendix B.

SUBSURFACE CONDITIONS

Published Geologic Data

Published geology indicates that the soils at the site are sandy deposits, the product of both wave and wind action, known as beach sand. The soils are generally well sorted fine quartz sand intermixed with fine gravel or shell fragments.

The geologic information was obtained from the "Engineering Soil Survey of New Jersey," Rutgers University, Report Number 18, Atlantic County, Engineering Research Bulletin Number 32, 1955.

Soils Encountered

The site soils are in general agreement with the published geologic data. Fill soils were encountered at grade and were underlain predominantly by sandy soils which extended to the termination depth of the borings. A detailed description of the soils encountered is shown on the boring log. A brief general description is given in the following sections.

Fill (F): At grade in all four borings, granular fill or possible fill soils were encountered, and extended to a depth of 2 to 5 feet below existing grade. The soils in this stratum can be described brown and gray coarse to fine sand with little to trace silt and little to no fine crushed stone The relative density of this stratum varies from very loose to dense with normalized Standard Penetration Test (SPT) N_{60} values ranging from 3 to 35 blows per foot (bpf).

It should be noted, in the absence of foreign materials within the soil matrix, it may be difficult to differentiate between natural soils and fill or regraded soils, even when classified by experienced engineers. Accordingly, the depth of fill could vary from that indicated on the boring logs. However, due to the presence of crushed stone this stratum is considered to be fill.

Sandy Deposits (S): Underlaying the fill stratum, granular sand deposits were encountered and extended to the termination depth of all borings. The soils in this stratum can be described as gray coarse to fine sand with some to trace silt, some to

no fine gravel and little to no fine shell fragments. In borings B-2 and B-3, a thin 12 inch layer of brown and gray organic silt with little to trace fine sand and trace clay was encountered. This layer of organic was encountered at a depth of 5 to 6 feet in boring B-2 and at a depth of 7 to 8 feet in boring B-3. Also in boring B-2 and boring B-3, gray micaceous silt with little clay and little fine sand was encountered at a depth of 50 feet below existing grade, and extended to the termination depth of these borings. The relative density of the soils in this stratum varies from loose to very dense with normalized SPT N_{60} and $N1_{60}$-values ranging from 4 to over 50 bpf.

Groundwater

Groundwater was encountered in all borings at depths of 2 to 3 feet below existing grade at the time of our drilling operations. It should be noted that this groundwater information represents the conditions encountered at the time of the drilling operations. Groundwater levels generally can fluctuate due to tidal influences, changes in precipitation, infiltration, surface run-off and other hydrogeological factors. Therefore, the groundwater level present at the time of construction may vary from that observed at the time of the drilling operations.

It should also be noted that shallow or perched groundwater might be encountered during excavations for foundation construction, especially if the work commences after a wet weather period. Dewatering of perched water or surface runoff water encountered during construction can be performed using sump pumps.

DISCUSSION & RECOMMENDATIONS

Based on the results of our field investigation, we have carried out evaluations of the existing subsurface soil conditions to determine their engineering properties for the support of the proposed new building, from a geotechnical engineering point of view. The subsurface investigation indicated that the site is underlain by granular fills over natural granular alluvial soils that can be utilized to support the proposed structure after the below site preparation and earthwork operation have been completed.

Site Preparation Procedures & Earthwork Operations

The proposed construction area is defined as the area within the proposed building limits, and a 5-ft and 3-ft wide zone outside the building addition and pavements, respectively.

1. Clear and strip from the construction area, any existing vegetation, pavements or any other deleterious material. Any existing utilities found within the proposed building limits will have to be rerouted outside the building footprint. Any debris, old foundations or abandoned pipes encountered during excavation, will have to be removed completely from the area under the proposed building to a minimum depth of 2 feet below the bottom slab elevation and completely from the area of

the foundations. If any pipes are to be left in place, they ' completely filled with cement grout.

2. Excavate the site, where necessary, to proposed sub vations. Over-excavate any unsuitable material or soils encountered be is elevation in the zone of influence of the foundations. The zone of influence is the volume of soil within lines drawn downward and outward, from the lower edges of a foundation, at a slope of 1.5H:1V. Unsuitable material includes all deleterious material, bricks, debris, rubble, or any other undesirable material designated by the on-site representative of the Geotechnical Engineer. Undesirable natural soils include all soft and loose soils encountered under the bottom of the foundation elevation. Replace the over-excavated material with controlled structural fill as defined herein.

3. After excavation to proposed subgrade and prior to the placement of any fill, the resulting subgrade should be rigorously proof rolled and compacted with a 10-ton heavy-duty vibratory roller. This should be done during a dry and favorable weather period, and under the technical supervision of a representative of the Geotechnical Engineer. A minimum of 8 overlapping passes is recommended to densify the upper 2 to 4 feet of on-site soils. The vibratory mode should be turned off within 20 feet of existing structures. No heavy equipment should be operated within 5 feet of existing structures. Compaction in the vicinity of existing structures should be accomplished using a mechanical compactor such as a walk behind roller or similar device as approved by the Geotechnical Engineer.

4. Undercut any zones of instability disclosed by the proof rolling, as determined by the on-site representative of the Geotechnical Engineer and replace the undercut material with controlled structural fill as defined herein. As required, raise the ground surface to the proposed subgrade elevation with controlled structural fill. All material used as controlled structural fill material in the building area should comply with the requirements given herein and approved by the on-site representative of the Geotechnical Engineer.

5. All load-bearing fill should be controlled structural fill placed in loose horizontal lifts with a maximum thickness of 8 inches. Controlled structural fill should consist of inorganic, readily compactable, predominantly well-graded granular soils with no more than 12% fines (material passing the No. 200 sieve), and a maximum particle size of 3 inches. The moisture content of the fill materials should be controlled to within 2% of the optimum moisture content, as determined by ASTM D 1557, by wetting, aeration or blending, as necessary. It is recommended that controlled fill within the construction area be compacted to at least 95% of the maximum dry density, as determined by the Modified Proctor Test (ASTM D 1557). In addition, it is recommended that all fills be stable without significant movement under construction traffic, as judged by the on-site representative of the Geotechnical

Engineer. Quality control testing of in-place fill densities should be conducted throughout the entire earthwork operation.

6. Permanent slopes should not be steeper than 2H:1V and provision should be made to protect the surface against erosion by covering the surface with riprap or a suitable vegetative cover.

Excavation

Open excavations are feasible provided there is enough room so that the stability of the existing underground utilities and structures are not affected. The existing utilities and structures may be considered not affected by the open cut excavation if a line projected downward from the bottom of the existing utility or structure at a 1.5H:1V does not intersect the excavation slope. Any section of the existing utilities and structures affected by the excavation should be supported by temporary sheeting and shoring system. The side slopes of the open cut should not be steeper than 2H:1V.

If temporary sheeting or shoring system is utilized, the soil parameters presented in the table below are suggested for the design of the shoring. All excavations should be in compliance with "Excavating and Trenching Operations," manual (latest revision), issued by the US Department of Labor, OSHA 2226, and local requirements.

Temporary Shoring Design Parameters

Unit Weight of Soil (pcf)	120
Buoyant Unit Weight of Soil (pcf)	58
Angle of Internal Friction (ϕ)	30°
Coefficient of Active Earth Pressure (K_a)	0.30
Coefficient of Earth Pressure At-rest (K_o)	0.50
Coefficient of Passive Earth Pressure (K_p)	3.0*

* A suitable factor of safety should be applied to K_p

The lateral load information presented in this report should be used only as a guideline by the contractor, and it should be a requirement for the excavation contractor to prepare a proposed sheeting design certified by a licensed professional engineer prior to construction. The excavation contractor should be responsible for the design, installation, and maintenance of all sheeting and shoring.

Regardless of the excavation option chosen, excavated soils should not be stockpiled adjacent to the sides of the excavations to avoid the imposition of additional loads, unless these loads are considered in the design of the temporary shoring or side slopes.

Additionally, the effect of excavation machinery should be included in the stability of the open cut slopes, as well as the temporary shoring design.
Excavated granular soils approved by the Geotechnical Engineer may be stockpiled on-site for use as a component of the backfill material. The moisture content will have to be kept as close as possible to the optimum moisture content of this material, if it is to be placed successfully as controlled fill.

Dewatering

Groundwater was encountered in the borings at a depth of 2 to 3 feet below existing grade at the time of our drilling operation. Due to this, it is anticipated that continuous dewatering operations will be required for foundation construction.

Pumping from screened sumps, deep wells, or well points are suitable dewatering methods for excavations deeper than groundwater. If sumps are to be used, the spacing of sumps must be close enough to avoid any upward flow of groundwater between the sumps that may cause a "quick" condition. Dewatering specifications should be of the performance type requiring the contractor to maintain groundwater levels at least 2 feet below the prevailing bottom of the excavation at all times. The dewatering should be continuous during construction operations and until backfill has been placed and compacted at least 2 feet above natural groundwater level.

Groundwater levels encountered during construction may vary somewhat from those levels shown on the boring logs due to tidal influences, seasonal variations or climatic conditions. There for the information obtained during the drilling operation may not be present at the time of construction.

Backfill

The clean granular portions of the existing on-site soils can be reused as backfill after approval by the Geotechnical Engineer. Soils with organic or other deleterious materials should be discarded. The moisture content of the soil must be within 2% of the optimum value for proper compaction. Therefore, some adjustment of the moisture content may be necessary prior to use as fill material. If Imported fill materials are required to complete backfilling of the excavations, they should consist of uncontaminated, relatively well-graded granular soils as defined in Item 5 of the Site Preparation & Earthwork Operations portion of this report.

Backfilling against the foundations and for utility trenches, or other structural uses, should be accomplished using controlled structural fill, as defined in this report, compacted to 95% of the maximum dry density as determined by the Modified Proctor Test, ASTM D 1557. Compaction of the backfill within 5 ft of any existing structures should be carried out with relatively light equipment such as a jumping jack, a walk behind roller, or similar device as approved by the on-site representative of the Geotechnical Engineer. The backfill should be

placed in 8-inch lifts and compacted to at least 95% and 90% of maximum dry density, as determined by the ASTM D-1557 test procedure, in structural areas and in paved or landscaped areas, respectively.

Pile Foundation

It is expected that the building will be supported by a deep foundation system such as piles. Concrete filled steel pipe piles will be suitable for the support of the proposed DPW Building. Based on the static analysis these piles will derive their capacities by a combination of shaft resistance and end bearing capacity as presented on the tables below.

14-inch Concrete Filled Steel Pipe Pile	
Estimated Pile Length below existing grade(feet)	40
Nominal Axial Compression Capacity (kips)	200
Factored Axial Compression Capacity (kips)	80
Axial Compression Resistance Factor	0.4
Settlement @ 80 kips (inches)	0.017
Nominal Uplift Capacity (kips)	40
Factored Uplift Capacity (kips)	20
Uplift Resistance Factor	0.5
Lateral Capacity (kips)	10
Lateral Resistance Factor	1.0
Lateral Deflection (inches)	0.21

The steel pipe piles should have a minimum wall thickness of 0.375 inches and a yield stress of at least 50 ksi (ASTM A-252, Grade 3 modified). The pile shall be coated full length with coal tar epoxy, 16 mils dry film thickness. Concrete placed in the pipe piles should have a minimum 28-day compressive strength of 4,000 psi. The pipe tips should be closed with a flat plate with minimum 1 inch thickness, welded flush with the outside diameter of the pipe (no projection). The minimum spacing of the piles shall be 3 pile diameters but not less than 3 feet center to center. It is recommended that a minimum tip elevation of 35 feet below existing grade be achieved to be below a layer of softer soil encountered from 20 to 30 feet below existing grade.

Two (2) "drive test pile" should be installed to determine the driving characteristics and the required pile lengths more accurately. A wave equation analysis (WEAP) should be performed and submitted to the geotechnical engineer for review prior to the installation of the test piles. PDA and CAPWAP analyses should be carried out during installation of the test piles to determine the required driving criteria for the production piles and to verify that the safe design load capacity is achieved.

With the use of a pipe pile foundation, as recommended, the total and differential settlements for the proposed elevated emergency generator structure will be within tolerable limits.

All pile installation should be performed in the full-time presence of a representative of a Professional Engineer, who should evaluate and correlate the driving data and depth of penetration of each pile with the results of our static analyses and the test boring data. The representative should ensure that the tip elevation of each pile is satisfactorily located in the proper bearing stratum and that the required compression load capacity of each pile is attained, based on the driving resistance.

Floor Slabs

Proposed reinforced concrete floor slabs can be uniformly supported on the densified natural soil or controlled structural fill after site preparation procedures have been successfully completed as discussed herein. The slabs should be structurally independent of walls and footings. Large floor areas should be provided with joints at frequent intervals as determined by the structural engineer. A minimum of 4 inches of ¾-inch clean crushed stone or a 12-inch thick layer (minimum) of well-graded sand and gravel with not more than 5% non-plastic fines is recommended below the slab to assure uniform bearing conditions and to act as a capillary break. A vapor barrier should be placed between the slab and base course, as directed by the Architect, to minimize moisture migration to the surface. All structural fill supporting the floor slab should be compacted to 95% of the maximum dry density (ASTM D 1557).

Concrete slabs placed on the subgrade, prepared as described herein, can be designed using a modulus of subgrade reaction of 150 pounds per cubic inch (pci).

Seismic Zone

According to the New Jersey Edition of the 2021 International Building Code, Section 1613.2.2 referencing ASCE 7, Chapter 20 the project site is categorized as a Site Class "D" for seismic design purposes. This classification is based on subsoil conditions encountered in the borings.

LIMITATIONS

The conclusions and recommendations contained in this report are based upon the subsurface data obtained during this investigation and on details stated in this report. It is understood that the number of borings made are consistent with good engineering practice, but actual conditions encountered may differ significantly from those projected in this report. Should conditions arise which differ from those described in this report, **RVE** should be notified immediately and provided with all information regarding differing subsurface conditions.

Our recommendations are based upon the assumption that the services of a qualified Geotechnical Engineer will be retained during construction for the observation of all critical earthwork operations and foundation installation. **RVE** cannot minimize, or provide recommended solutions for, any problems resulting from construction or differing soil conditions unless our services include full-time construction inspection to determine that the work performed is in compliance with **RVE's** recommendations, and to ensure the work is carried out in the owner's best interests.

Environmental considerations and contaminants, such as petroleum products, hazardous waste, radioactivity, irritants, pollutants, radon or other dangerous substances and conditions were not the subject of this study. Their presence and/or absence are not implied, inferred or suggested by this report or results of this study.

This report is intended for use with regard to the specific project discussed herein, and any changes in the design of the structure or location, however slight, should be brought to our attention so that we may determine how they may affect our conclusions. We are responsible for the conclusions and opinions contained in this report based on the data relating only to the specific project and location discussed herein.

Appendix A

Site Location Map/USGS Quadrangle



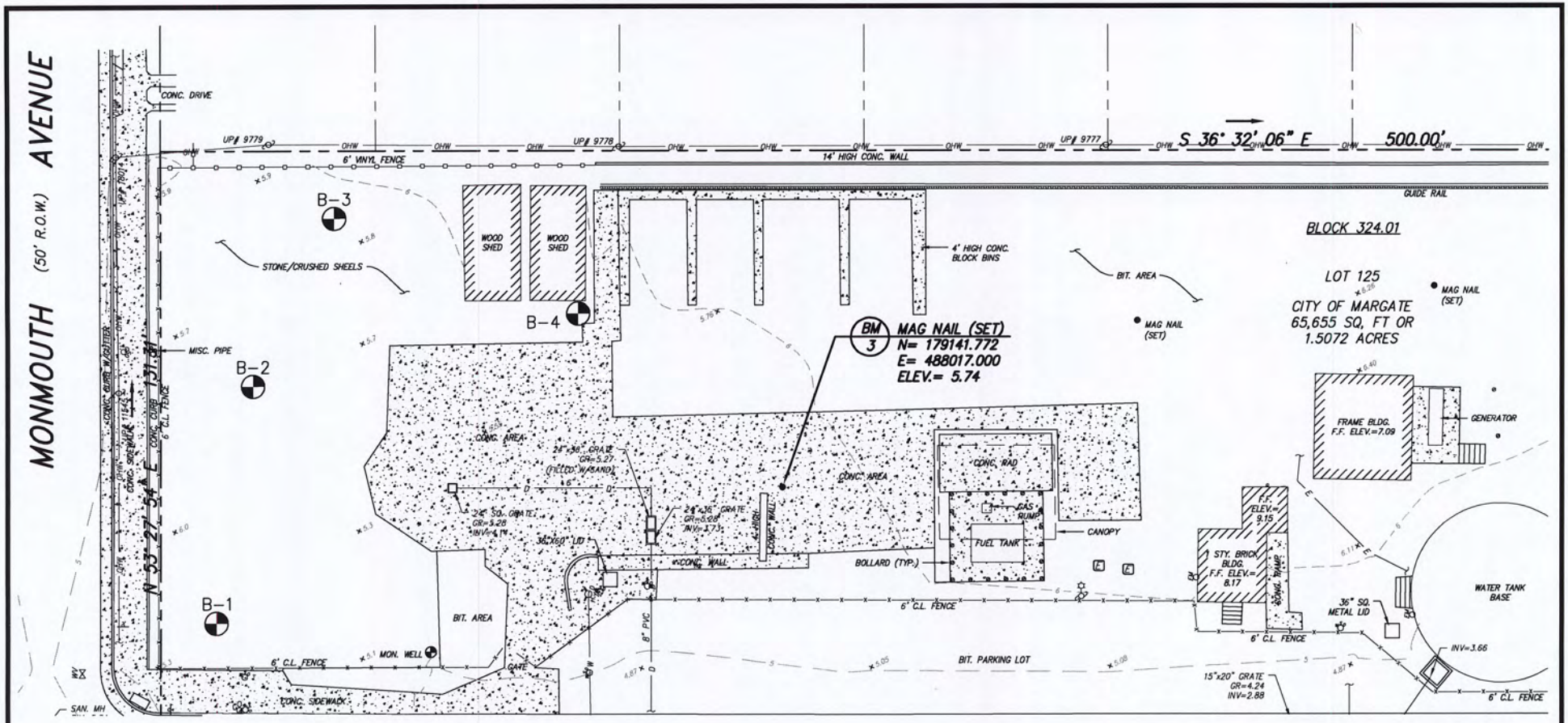
Site Location Map/USGS Quadrangle

Proposed New Public Works Building

Margate City, Atlantic County, New Jersey

Appendix B

Soil Boring Location Plan



GRAPHIC SCALE

20 0 10 20

(IN FEET)

1 inch = 20 ft.

LEGEND

B-1 DENOTES NUMBER AND APPROXIMATE LOCATION OF TEST BORINGS

NO.	REVISION	DATE	BY	CHK.

BORING LOCATION PLAN

MARGATE DPW BUILDING

MARGETE, ATLANTIC COUNTY, NEW JERSEY

RVE

REMINGTON & VERNICK ENGINEERS GA 27045

2059 SPRINGDALE ROAD, CHERRY HILL, NJ 08002

(856) 795-9595, FAX (856) 795-1882, WEB SITE ADDRESS: WWW.RVE.COM

SCALE	DATE	DRAWN BY	DSGN. BY	CHK'D. BY	DWG. NO.	SHEET NO.
1"=20'	9/2024	C.O.G.	K.C.W.	K.C.W.		1 OF 1

DWG FILE PATH/NAME

Appendix C

Soil Test Boring Logs

REMINGTON & VERNICK ENGINEERS

SOIL BORING LOG

Project No. 0116-U-200 **Project** New Public Works Building **Boring No.** B-1

Date Started: 8/19/24 **Location** 101 North Benson Avenue, Margate, New Jersey **Sheet** 1 **of** 2

Date Finished: 8/19/24 **Client** Margate City **Surface Elev.** Ex. Grade

Drilling Contractor: Boring Brothers, Inc. **Groundwater Data**

Drilling Method: Mud-Rotary **Depth** 2.5 ft

Hammer Type: Automatic **Driller:** Matt Daniels **Date** 8/19/24

Equipment: CME-75 Track Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
0		S-1	4-4-3-3	18"		Brown f SAND, little Silt (Possible FIll)			
		S-2	4-3-4-3	20"		Brown and gray f SAND, little Silt (Possible Fill)			
5		S-3	4-5-5-5	20"		Gray f SAND, little Silt			
		S-4	7-7-7-6	16"		Gray f SAND, some Silt			
		S-5	4-5-7-7	18"		Gray f SAND, little Silt			
10		S-6	5-6-11-9	10"					
15		S-7	7-7-9-13	12"					
20		S-8	1-3-5-17	12"		Gray m-f SAND, trace Silt			
25		S-9	10-12-12-17	14"		Gray f SAND, little Silt			
30		S-10	9-14-23-26	14"					
35									

REMINGTON & VERNICK ENGINEERS

SOIL BORING LOG

Project No. 0116-U-200 **Project** New Public Works Building **Boring No.** B-1

Date Started: 8/19/24 **Location** 101 North Benson Avenue, Margate, New Jersey **Sheet** 2 **of** 2

Date Finished: 8/19/24 **Client** Margate City **Surface Elev.** Ex. Grade

Drilling Contractor: Boring Brothers, Inc. **Groundwater Data**

Drilling Method: Mud-Rotary **Depth** 2.5 ft

Hammer Type: Automatic **Driller:** Matt Daniels **Date** 8/19/24

Equipment: CME-75 Track Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
		S-11	2-3-5-8	18"		Gray c-f SAND, little f Shell Fragments, trace Silt			
40		S-12	15-20-23-24	14"		Gray f SAND, trace Silt			
45		S-13	12-16-16-20	12"					
50		S-14	13-14-13-13	10"					
						Boring End at 52 Feet			
55									
60									
65									
70									

REMINGTON & VERNICK ENGINEERS

SOIL BORING LOG

Project No. 0116-U-200 **Project** New Public Works Building **Boring No.** B-2

Date Started: 8/19/24 **Location** 101 North Benson Avenue, Margate, New Jersey **Sheet** 1 **of** 2

Date Finished: 8/19/24 **Client** Margate City **Surface Elev.** Ex. Grade

Drilling Contractor: Boring Brothers, Inc. **Groundwater Data**

Drilling Method: Mud-Rotary **Depth** 3 ft

Hammer Type: Automatic **Driller:** Matt Daniels **Date** 8/19/24

Equipment: CME-75 Track Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
0		S-1	5-7-6-7	16"		Gray f SAND, little Silt (Possible Fill)			
		S-2	5-7-6-5	16"		Gray & brown f SAND, little Silt (Possible Fill)			
5		S-3	2-1-1-2	20"		Dark brown ORGANIC SILT, little f Sand, trace Clay			
		S-4	6-8-8-8	18"		Gray f SAND, little Silt			
		S-5	6-7-12-18	14"					
10		S-6	8-10-13-15	20"		Gray f SAND, trace Silt			
15		S-7	7-7-8-10	18"		Gray f SAND, little Silt			
20		S-8	1-2-5-5	6"		Gray m-f SAND, trace Silt			
25		S-9	8-8-6-6	10"					
30		S-10	9-12-14-14	20"		Gray f SAND, little Silt			
35									

REMINGTON & VERNICK ENGINEERS

SOIL BORING LOG

Project No. 0116-U-200 **Project** New Public Works Building **Boring No.** B-2

Date Started: 8/19/24 **Location** 101 North Benson Avenue, Margate, New Jersey **Sheet** 2 **of** 2

Date Finished: 8/19/24 **Client** Margate City **Surface Elev.** Ex. Grade

Drilling Contractor: Boring Brothers, Inc. **Groundwater Data**

Drilling Method: Mud-Rotary **Depth** 3 ft

Hammer Type: Automatic **Driller:** Matt Daniels **Date** 8/19/24

Equipment: CME-75 Track Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
		S-11	6-6-6-5	18"		Gray m-f SAND, trace Silt			
40		S-12	9-9-8-7	20"		Gray f SAND, little Silt			
45		S-13	13-14-19-22	16"					
50		S-14	8-11-10-11	16"		Dark micaceous gray SILT, little Clay, little f Sand			
						Boring End at 52 Feet			
55									
60									
65									
70									

REMINGTON & VERNICK ENGINEERS

SOIL BORING LOG

Project No. 0116-U-200 **Project** New Public Works Building **Boring No.** B-3

Date Started: 8/16/24 **Location** 101 North Benson Avenue, Margate, New Jersey **Sheet** 1 **of** 2

Date Finished: 8/16/24 **Client** Margate City **Surface Elev.** Ex. Grade

Drilling Contractor: Boring Brothers, Inc. **Groundwater Data**

Drilling Method: Mud-Rotary **Depth** 2 ft

Hammer Type: Automatic **Driller:** Matt Daniels **Date** 8/19/24

Equipment: CME-75 Track Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
0		S-1	7-12-14-12	16"		Gray c-f SAND, little f Crushed Stone, trace Silt (Fill)			
		S-2	5-7-8-7	12"		Gray f SAND, little Silt			
5		S-3	2-6-4-2	20"					
		S-4	3-2-1-2	20"		Brown & gray ORGANIC SILT, trace Clay, trace f Sand			
		S-5	3-6-9-16	20"		Gray f SAND, little Silt			
10		S-6	10-11-10-11	20"					
15		S-7	7-11-11-13	20"					
20		S-8	9-7-5-7	14"		Gray m-f SAND, little Silt			
25		S-9	7-4-8-8	18"					
30		S-10	6-8-10-14	20"		Gray m-f SAND, trace Silt			
35									

REMINGTON & VERNICK ENGINEERS

SOIL BORING LOG

Project No. 0116-U-200 **Project** New Public Works Building **Boring No.** B-3

Date Started: 8/16/24 **Location** 101 North Benson Avenue, Margate, New Jersey **Sheet** 2 **of** 2

Date Finished: 8/16/24 **Client** Margate City **Surface Elev.** Ex. Grade

Drilling Contractor: Boring Brothers, Inc. **Groundwater Data**

Drilling Method: Mud-Rotary **Depth** 2 ft

Hammer Type: Automatic **Driller:** Matt Daniels **Date** 8/19/24

Equipment: CME-75 Track Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
		S-11	9-7-5-4	20"		Gray c-f SAND, little f Gravel, trace Silt			
40		S-12	13-11-10-12	16"		Gray f SAND, little Silt			
45		S-13	14-12-17-18	20"		Gray f SAND, some Silt			
50		S-14	4-5-5-5	16"		Gray SILT, little Clay, little f Sand			
						Boring End at 52			
55									
60									
65									
70									

REMINGTON & VERNICK ENGINEERS

SOIL BORING LOG

Project No. 0116-U-200 **Project** New Public Works Building **Boring No.** B-4

Date Started: 8/16/24 **Location** 101 North Benson Avenue, Margate, New Jersey **Sheet** 1 **of** 2

Date Finished: 8/16/24 **Client** Margate City **Surface Elev.** Ex. Grade

Drilling Contractor: Boring Brothers, Inc. **Groundwater Data**

Drilling Method: Mud-Rotary **Depth** 2 ft

Hammer Type: Automatic **Driller:** Matt Daniels **Date** 8/16/24

Equipment: CME-75 Track Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered and observation of materials returned between samples)	Stratum	Moisture Content, %	Other Tests
0		S-1	7-7-7-6	16"		Light brown and gray f SAND, trace Silt (Possible Fill)			
		S-2	3-2-3-4	NR					
5		S-3	4-5-5-6	20"		Brown and gray f SAND, little Silt (Possible Fill)			
		S-4	5-6-6-7	20"		Gray f SAND, trace Silt			
		S-5	7-7-11-13	20"					
10		S-6	12-11-14-15	16"					
15		S-7	8-9-11-13	20"					
20		S-8	3-3-4-8	20"		Gray SILT, little Clay, little f Sand			
25		S-9	11-14-16-20	20"		Gray f SAND, little Silt			
30		S-10	12-11-13-16	14"		Gray m-f SAND, little Silt			
35									

REMINGTON & VERNICK ENGINEERS

SOIL BORING LOG

Project No. 0116-U-200 **Project** New Public Works Building **Boring No.** B-4

Date Started: 8/16/24 **Location** 101 North Benson Avenue, Margate, New Jersey **Sheet** 2 **of** 2

Date Finished: 8/16/24 **Client** Margate City **Surface Elev.** Ex. Grade

Drilling Contractor: Boring Brothers, Inc. **Groundwater Data**

Drilling Method: Mud-Rotary **Depth** 2 ft

Hammer Type: Automatic **Driller:** Matt Daniels **Date** 8/16/24

Equipment: CME-75 Track Rig **Inspector:** Chris Gilbert **Time** During

Depth (ft.)	Sample Type	Sample Number	Blow Count (Blows per 6 inches)	Recovery	Lithology	Classification of Materials (Based upon samples recovered of materials returned between sam ation	Stratum	Moisture Content, %	Other Tests
		S-11	8-12-14-13	16"		Gray c-f SAND, some f Gravel, little Silt			
40		S-12	25-24-24-30	16"		Gray f SAND, little Silt			
45		S-13	26-31-33-40	10"					
50		S-14	28-29-27-28	10"					
						Boring End at 52 Feet			
55									
60									
65									
70									

MODIFIED METHOD
FOR
IDENTIFICATION OF SOILS
AFTER
DR. D. M. BURMISTER

Soil Component	Descriptive Terms As Written on Log	Range of Proportions
PRINCIPAL COMPONENT (All Letters Capitalized)	-	35% or more
MINOR COMPONENTS (First Letter Capitalized)	and (a.)	35% to 50%
	some (s.)	20% to 35%
	little (l.)	10% to 20%
	trace (tr.)	1% to 10%

Coarse Grained Soils-Gradation of Components

Coarse to fine	cf	All sizes
Coarse to medium	cm	Less than 10% fine
Medium to fine	mf	Less than 10% coarse
Coarse	c	Less than 10% medium & fine
Medium	m	Less than 10% coarse & fine
Fine	f	Less than 10% coarse & medium

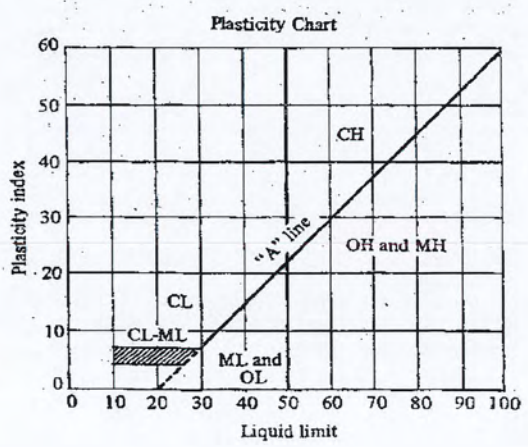
Component	Symbol	Sieve Range
Boulders		9" and larger
Cobbles		3" to 9"
Gravel	G	
Coarse		¾" to 3"
Fine		#4 to ¾"
Sand	S	
Coarse		#4 to #10
Medium		#10 to #40
Fine		#40 to #200

Fine Grained Soils-Plasticity of Components

Component	Symbol	Overall Plasticity	Plasticity Index
SILT	S	Non-Plastic	0
CLAYEY SILT	CyS	Slight	1 to 5
SILT & CLAY	S & C	Low	5 to 10
CLAY & SILT	C & S	Medium	10 to 20
SILTY CLAY	SyC	High	20 to 40
CLAY	C	Very High	over 40

UNIFIED SOIL CLASSIFICATION SYSTEM. (ASTM D-2487)

Major Divisions			Group Symbols	Typical Names	Laboratory Classification Criteria		
Coarse-grained soils (More than half of material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 per cent: GW, GP, SW, SP; More than 12 per cent: GM, GC, SM, SC; 5 to 12 per cent: *Borderline* cases requiring dual symbols[b]	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	Poorly graded gravels, gravel-sand mix-tures, little or no fines		Not meeting all gradation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	GM[a] d / u	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. Less than 4	Above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mix-tures		Atterberg limits above "A" line with P.I. Greater than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM[a] d / u	Silty sands, sand-silt mixtures		Atterberg limits above "A" line or P.I. Less than 4	Limits plotting in hatched zone with P.I. Between 4 and 7 are *borderline* cases requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures		Atterberg limits above "A" line with P.I. Greater than 7	
Fine-grained soils (More than half material is smaller than No. 200 sieve)	Silts and clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity			
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL	Organic silts and organic silty clays of low plasticity			
	Silts and clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH	Inorganic clays of high plasticity, fat clays			
			OH	Organic clays of medium to high plasticity, organic silts			
	Highly organic soils		Pt	Peat and other highly organic soils			



[a]Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg limits; suffix d used when L.L. is 28 or less and the P.I. Is 6 or less; the suffix u used when L.L. is greater than 28.

[b]Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC, well-graded gravel-sand mixture with clay binder.

Appendix D

Normalized N-Values

NORMALIZED and CORRECTED N-VALUES

New Public Works Building
Margate City, NJ

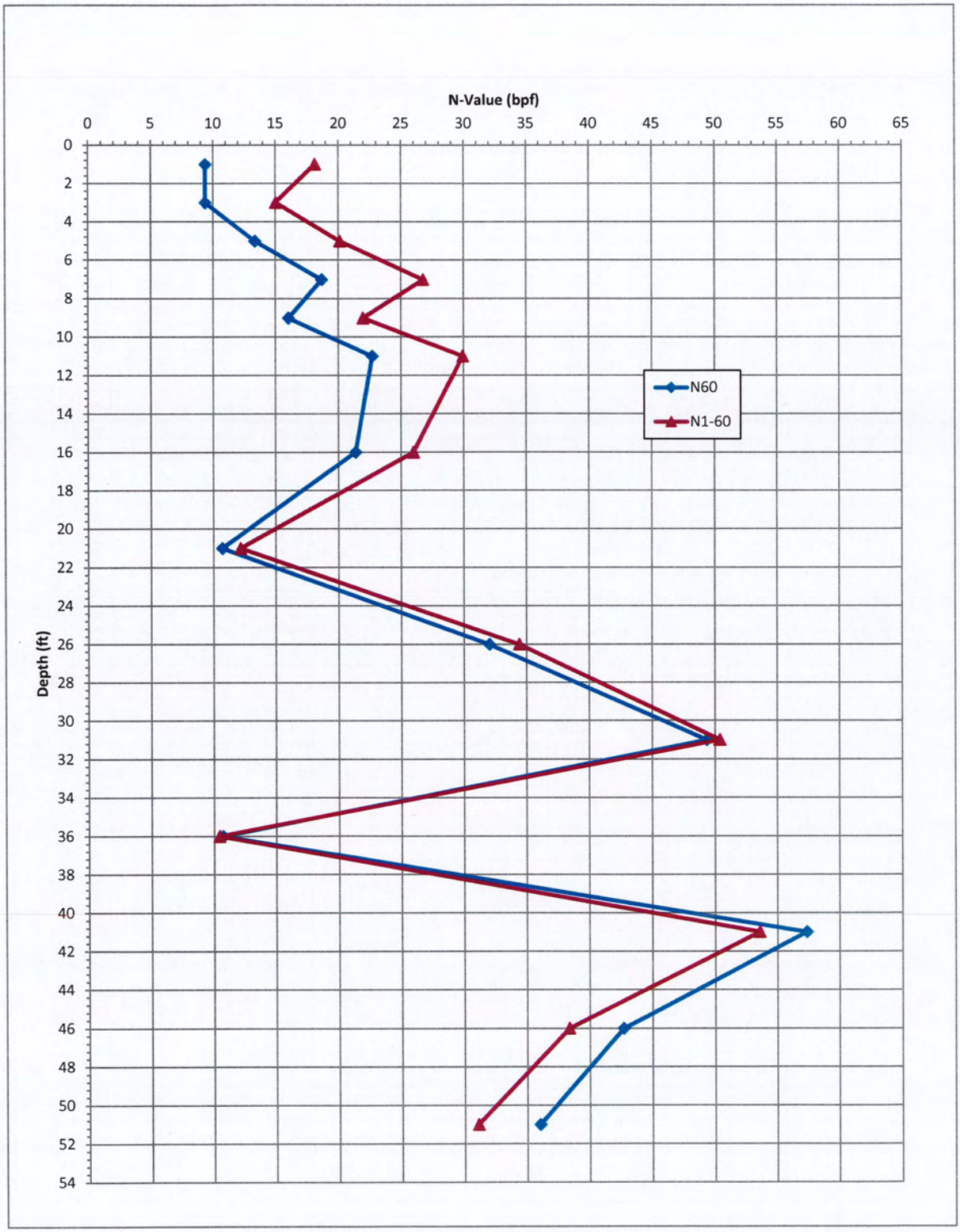
Boring No.	B-1
Elevation, ft	0
Groundwater Depth, ft	2.5
Hammer Type	Automatic
Hammer Efficiency, E	0.8

Formulas used	N60 = N(E/.6)
	$\sigma' = \sigma t - u$
	$CN = .77\log(40/\sigma')$ $CN < 2$ Only valid for $\sigma' \geq 0.5$ ksf
	N160 = N60*CN

Sample Number	Sample Depth	N-value Recored			N_{60}	γ	σt	u	σ'	C_N	$N1_{60}$
		Depth	Elev.	Value		pcf	ksf	ksf	ksf		
1	0 - 2	1	-1	7	9	120	0.12	0.00	0.12	1.94	18
2	2 - 4	3	-3	7	9	120	0.36	0.03	0.33	1.61	15
3	4 - 6	5	-5	10	13	120	0.60	0.16	0.44	1.51	20
4	6 - 8	7	-7	14	19	120	0.84	0.29	0.55	1.43	27
5	8 - 10	9	-9	12	16	120	1.08	0.42	0.66	1.37	22
6	10 - 12	11	-11	17	23	120	1.32	0.55	0.77	1.32	30
7	15 - 17	16	-16	16	21	120	1.92	0.87	1.05	1.22	26
8	20 - 23	21	-21	8	11	120	2.52	1.19	1.33	1.14	12
9	25 - 27	26	-26	24	32	120	3.12	1.51	1.61	1.07	34
10	30 - 32	31	-31	37	49	120	3.72	1.83	1.89	1.02	50
11	35 - 37	36	-36	8	11	120	4.32	2.15	2.17	0.97	10
12	40 - 24	41	-41	43	57	120	4.92	2.47	2.45	0.93	54
13	45 - 47	46	-46	32	43	120	5.52	2.79	2.73	0.90	38
14	50 - 52	51	-51	27	36	125	6.15	3.11	3.03	0.86	31

NORMALIZED and CORRECTED N-VALUES

New Public Works Building
Margate City, NJ



NORMALIZED and CORRECTED N-VALUES

New Public Works Building
Margate City, NJ

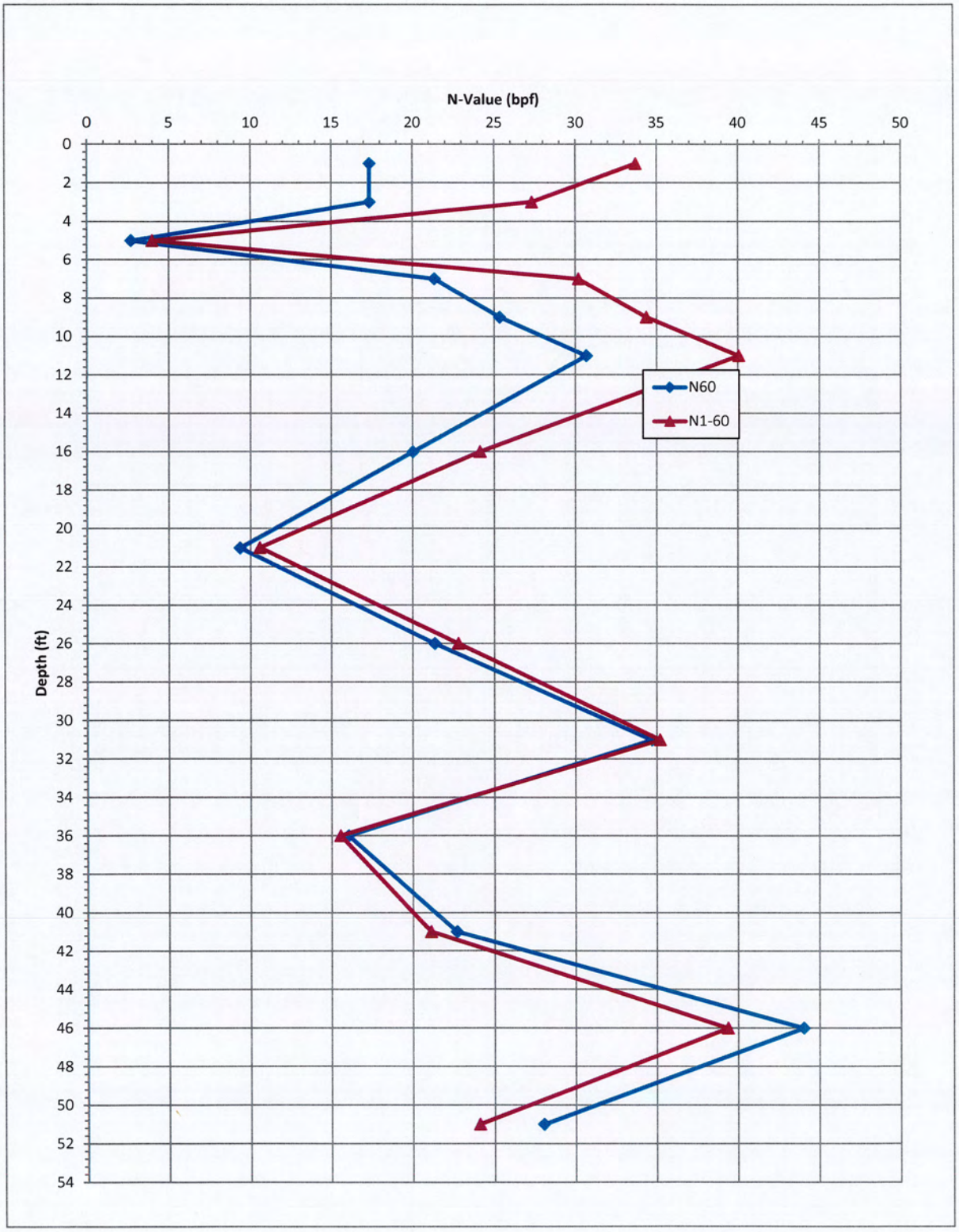
Boring No.	B-2
Elevation, ft	0
Groundwater Depth, ft	3
Hammer Type	Automatic
Hammer Efficiency, E	0.8

Formulas used	N60 = N(E/.6)
	$\sigma' = \sigma t - u$
	$CN = .77\log(40/\sigma')$ $CN < 2$ Only valid for $\sigma' \geq 0.5$ ksf
	N160 = N60*CN

Sample Number	Sample Depth	N-value Recored			N_{60}	γ	σt	u	σ'	C_N	$N1_{60}$
		Depth	Elev.	Value		pcf	ksf	ksf	ksf		
1	0 - 2	1	-1	13	17	120	0.12	0.00	0.12	1.94	34
2	2 - 4	3	-3	13	17	120	0.36	0.00	0.36	1.58	27
3	4 - 6	5	-5	2	3	120	0.60	0.13	0.47	1.48	4
4	6 - 8	7	-7	16	21	120	0.84	0.26	0.58	1.41	30
5	8 - 10	9	-9	19	25	120	1.08	0.39	0.69	1.36	34
6	10 - 12	11	-11	23	31	120	1.32	0.51	0.81	1.31	40
7	15 - 17	16	-16	15	20	120	1.92	0.83	1.09	1.21	24
8	20 - 23	21	-21	7	9	120	2.52	1.16	1.36	1.13	11
9	25 - 27	26	-26	16	21	120	3.12	1.48	1.64	1.07	23
10	30 - 32	31	-31	26	35	120	3.72	1.80	1.92	1.02	35
11	35 - 37	36	-36	12	16	120	4.32	2.12	2.20	0.97	16
12	40 - 24	41	-41	17	23	120	4.92	2.44	2.48	0.93	21
13	45 - 47	46	-46	33	44	120	5.52	2.76	2.76	0.89	39
14	50 - 52	51	-51	21	28	125	6.15	3.08	3.06	0.86	24

NORMALIZED and CORRECTED N-VALUES

New Public Works Building
Margate City, NJ



NORMALIZED and CORRECTED N-VALUES

New Public Works Building
Margate City, NJ

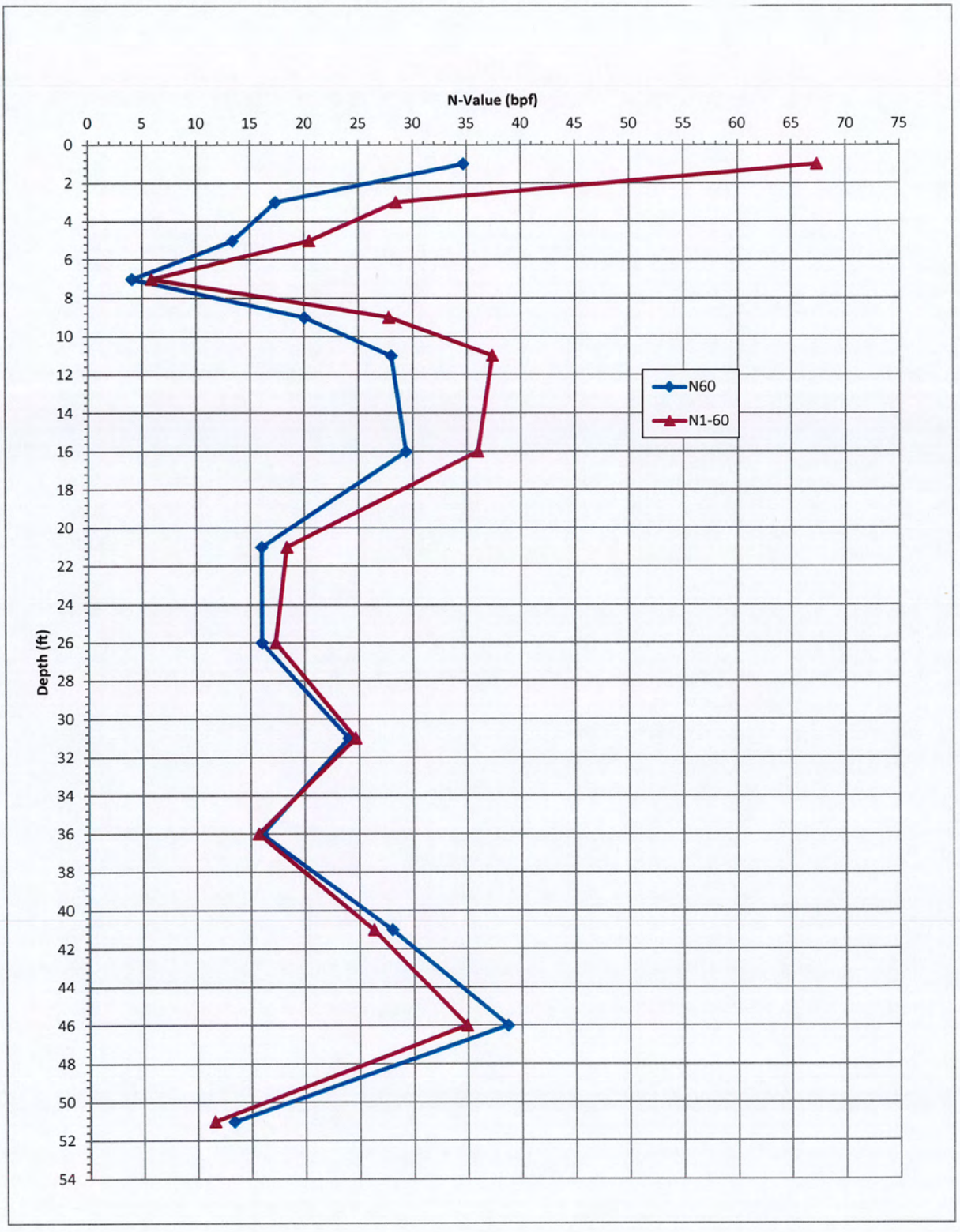
Boring No.	B-3
Elevation, ft	0
Groundwater Depth, ft	2
Hammer Type	Automatic
Hammer Efficiency, E	0.8

Formulas used	N60 = N(E/.6)
	$\sigma' = \sigma t - u$
	$CN = .77\log(40/\sigma')$ $CN < 2$ Only valid for $\sigma' \geq 0.5$ ksf
	N160 = N60*CN

Sample Number	Sample Depth	N-value Recored			N_{60}	γ	σt	u	σ'	CN	N160
		Depth	Elev.	Value		pcf	ksf	ksf	ksf		
1	0 - 2	1	-1	26	35	120	0.12	0.00	0.12	1.94	67
2	2 - 4	3	-3	13	17	120	0.36	0.06	0.30	1.64	28
3	4 - 6	5	-5	10	13	120	0.60	0.19	0.41	1.53	20
4	6 - 8	7	-7	3	4	120	0.84	0.32	0.52	1.45	6
5	8 - 10	9	-9	15	20	120	1.08	0.45	0.63	1.39	28
6	10 - 12	11	-11	21	28	120	1.32	0.58	0.74	1.33	37
7	15 - 17	16	-16	22	29	120	1.92	0.90	1.02	1.23	36
8	20 - 23	21	-21	12	16	120	2.52	1.22	1.30	1.15	18
9	25 - 27	26	-26	12	16	120	3.12	1.54	1.58	1.08	17
10	30 - 32	31	-31	18	24	120	3.72	1.86	1.86	1.03	25
11	35 - 37	36	-36	12	16	120	4.32	2.18	2.14	0.98	16
12	40 - 24	41	-41	21	28	120	4.92	2.50	2.42	0.94	26
13	45 - 47	46	-46	29	39	120	5.52	2.82	2.70	0.90	35
14	50 - 52	51	-51	10	13	125	6.15	3.15	3.00	0.87	12

NORMALIZED and CORRECTED N-VALUES

New Public Works Building
Margate City, NJ



NORMALIZED and CORRECTED N-VALUES

New Public Works Building
Margate City, NJ

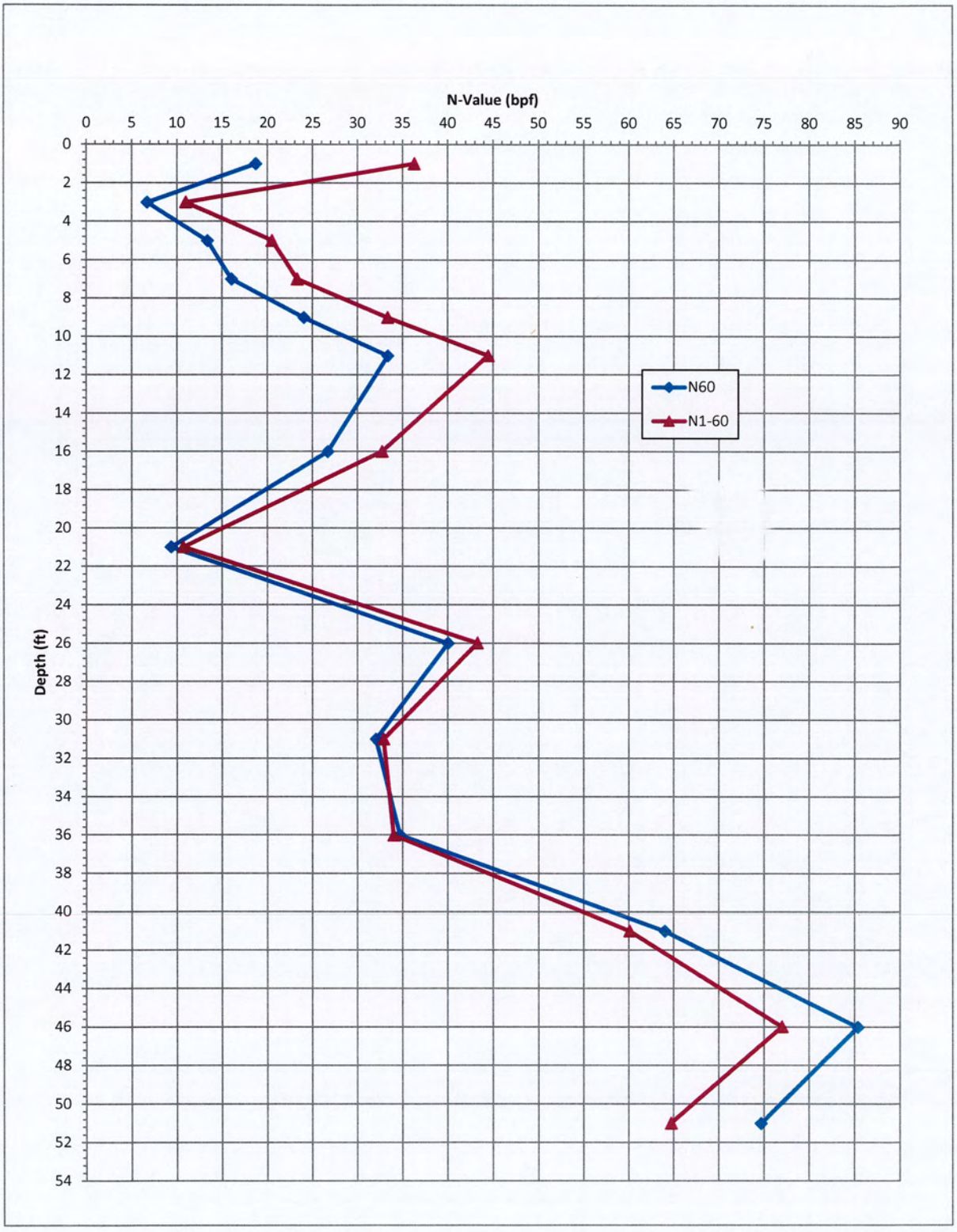
Boring No.	B-4
Elevation, ft	0
Groundwater Depth, ft	2
Hammer Type	Automatic
Hammer Efficiency, E	0.8

Formulas used	N60 = N(E/.6)
	$\sigma' = \sigma t - u$
	$CN = .77\log(40/\sigma')$ $CN < 2$ Only valid for $\sigma' \geq 0.5$ ksf
	N160 = N60*CN

Sample Number	Sample Depth	N-value Recored			N_{60}	γ	σt	u	σ'	CN	N160
		Depth	Elev.	Value		pcf	ksf	ksf	ksf		
1	0 - 2	1	-1	14	19	120	0.12	0.00	0.12	1.94	36
2	2 - 4	3	-3	5	7	120	0.36	0.06	0.30	1.64	11
3	4 - 6	5	-5	10	13	120	0.60	0.19	0.41	1.53	20
4	6 - 8	7	-7	12	16	120	0.84	0.32	0.52	1.45	23
5	8 - 10	9	-9	18	24	120	1.08	0.45	0.63	1.39	33
6	10 - 12	11	-11	25	33	120	1.32	0.58	0.74	1.33	44
7	15 - 17	16	-16	20	27	120	1.92	0.90	1.02	1.23	33
8	20 - 23	21	-21	7	9	120	2.52	1.22	1.30	1.15	11
9	25 - 27	26	-26	30	40	120	3.12	1.54	1.58	1.08	43
10	30 - 32	31	-31	24	32	120	3.72	1.86	1.86	1.03	33
11	35 - 37	36	-36	26	35	120	4.32	2.18	2.14	0.98	34
12	40 - 24	41	-41	48	64	120	4.92	2.50	2.42	0.94	60
13	45 - 47	46	-46	64	85	120	5.52	2.82	2.70	0.90	77
14	50 - 52	51	-51	56	75	125	6.15	3.15	3.00	0.87	65

NORMALIZED and CORRECTED N-VALUES

New Public Works Building
Margate City, NJ



Appendix E

Laboratory Test Results

SUMMARY OF LABORATORY TEST DATA

Project Name: New Public Works Facility, Margate, NJ
RVE #0116U200
Client Name: Remington & Vernick Engineers, Inc.
TRC Project #: 630396

SAMPLE IDENTIFICATION			Soil Group (USCS System)	Moisture Content (%)	GRAIN SIZE DISTRIBUTION USCS GRADATION			
Source #	Sample #	Depth (ft)			Gravel (%)	Sand (%)	Silt (%)	Clay (%)
B-1	S-11	35.0-37.0	SP	19.7	3.3	94.4	2.3	
B-1	S-12	40.0-42.0	SP-SM[1]	23.0	0.0	93.5	6.5	
B-2	S-8	20.0-22.0	SP	21.4	0.0	99.1	0.9	
B-3	S-10	30.0-32.0	SP	19.6	0.0	96.9	3.1	
B-3	S-11	35.0-37.0	SP	12.4	13.1	84.5	2.4	
B-4	S-8	20.0-22.0	SP	26.2	0.1	95.7	4.2	

Notes:

1. *USCS based on grain-size distribution and visual classification. An Atterberg limits test was not requested.*

DRAWN BY: TBT 09/17/24

CHECKED BY: JPB 09/17/24

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	3.3	2.2	14.7	77.5	2.3	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.5356	0.2469	0.1986	0.1327	0.0983	0.0886	0.81	2.79

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ GRAY POORLY GRADED SAND*	09/17/24	SP	19.7

Project No. 630396 **Client:** REMINGTON & VERNICK ENGINEERS, INC.

Project: NEW PUBLIC WORKS FACILITY, MARGATE, NJ

RVE #0116U200

○ **Source of Sample:** B-1 **Depth:** 35.0-37.0 FT **Sample Number:** S-11

TRC Engineers, Inc.

Mt. Laurel, NJ

Remarks:

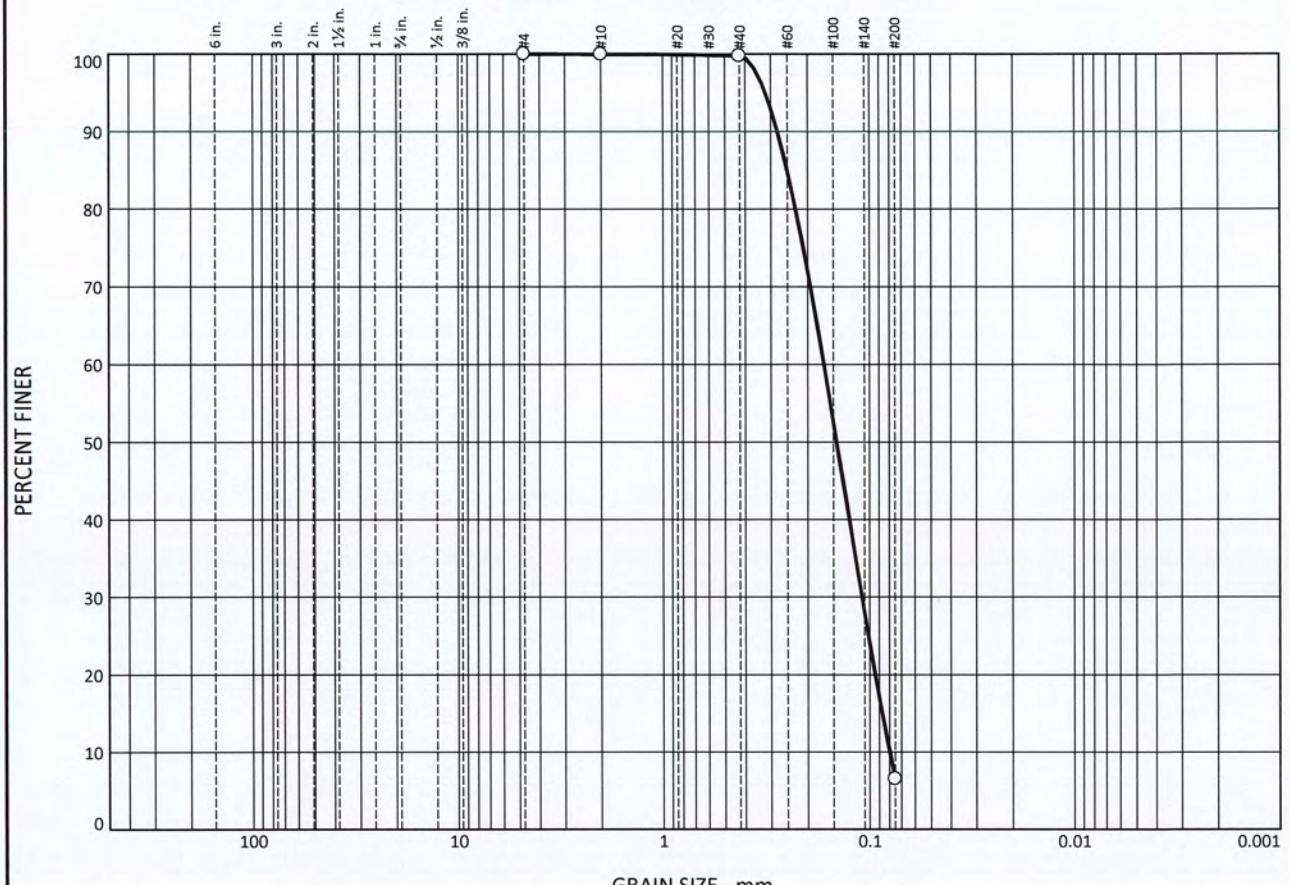
○SAMPLE DESCRIPTION BASED ON USCS

*SPECIMEN CONTAINS SHELLS

Figure 1

Tested By: JC 09/17/24 **Checked By:** JPB 09/17/24

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.2	93.3	6.5	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.2506	0.1666	0.1445	0.1090	0.0868	0.0798	0.89	2.09

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ GRAY POORLY GRADED SAND WITH SILT	09/17/24	SP-SM	23.0

Project No. 630396 **Client:** REMINGTON & VERNICK ENGINEERS, INC.

Project: NEW PUBLIC WORKS FACILITY, MARGATE, NJ
RVE #0116U200

○ **Source of Sample:** B-1 **Depth:** 40.0-42.0 FT **Sample Number:** S-12

TRC Engineers, Inc.

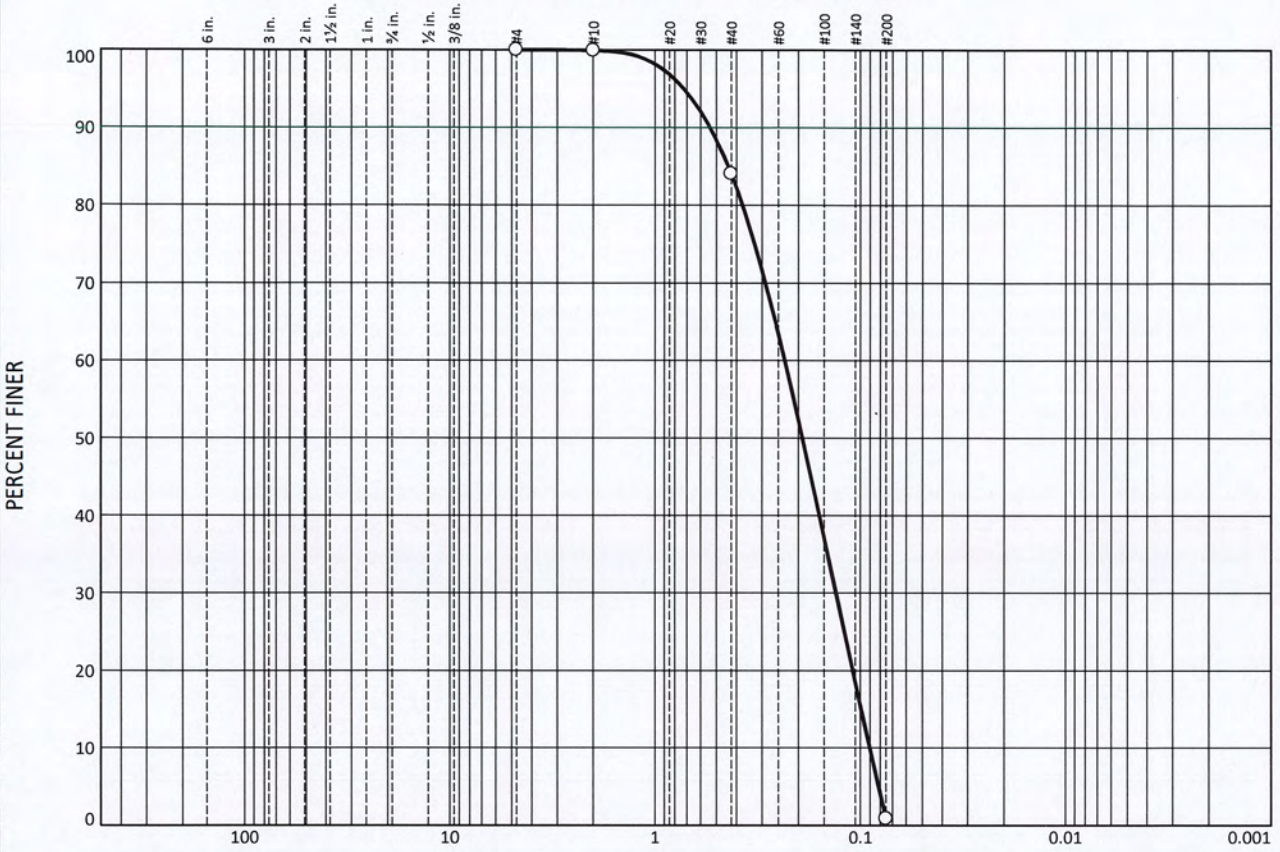
Mt. Laurel, NJ

Remarks:
○SAMPLE DESCRIPTION BASED ON GRAIN-SIZE DISTRIBUTION AND VISUAL CLASSIFICATION

Figure 2

Tested By: JC 09/17/24 **Checked By:** JPB 09/17/24

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.1	15.8	83.2	0.9	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.4393	0.2327	0.1907	0.1312	0.0992	0.0901	0.82	2.58

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ GRAY POORLY GRADED SAND	09/17/24	SP	21.4

Project No. 630396 **Client:** REMINGTON & VERNICK ENGINEERS, INC.

Project: NEW PUBLIC WORKS FACILITY, MARGATE, NJ

RVE #0116U200

○ **Source of Sample:** B-2 **Depth:** 20.0-22.0 FT **Sample Number:** S-8

Remarks:

○SAMPLE DESCRIPTION BASED ON USCS

TRC Engineers, Inc.

Mt. Laurel, NJ

Figure 3

Tested By: JC 09/17/24 **Checked By:** JPB 09/17/24

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	7.1	89.8	3.1	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.3128	0.1898	0.1614	0.1182	0.0928	0.0852	0.86	2.23

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ GRAY AND BROWN POORLY GRADED SAND	09/17/24	SP	19.6

Project No. 630396 **Client:** REMINGTON & VERNICK ENGINEERS, INC.

Project: NEW PUBLIC WORKS FACILITY, MARGATE, NJ

RVE #0116U200

○ **Source of Sample:** B-3 **Depth:** 30.0-32.0 FT **Sample Number:** S-10

TRC Engineers, Inc.

Mt. Laurel, NJ

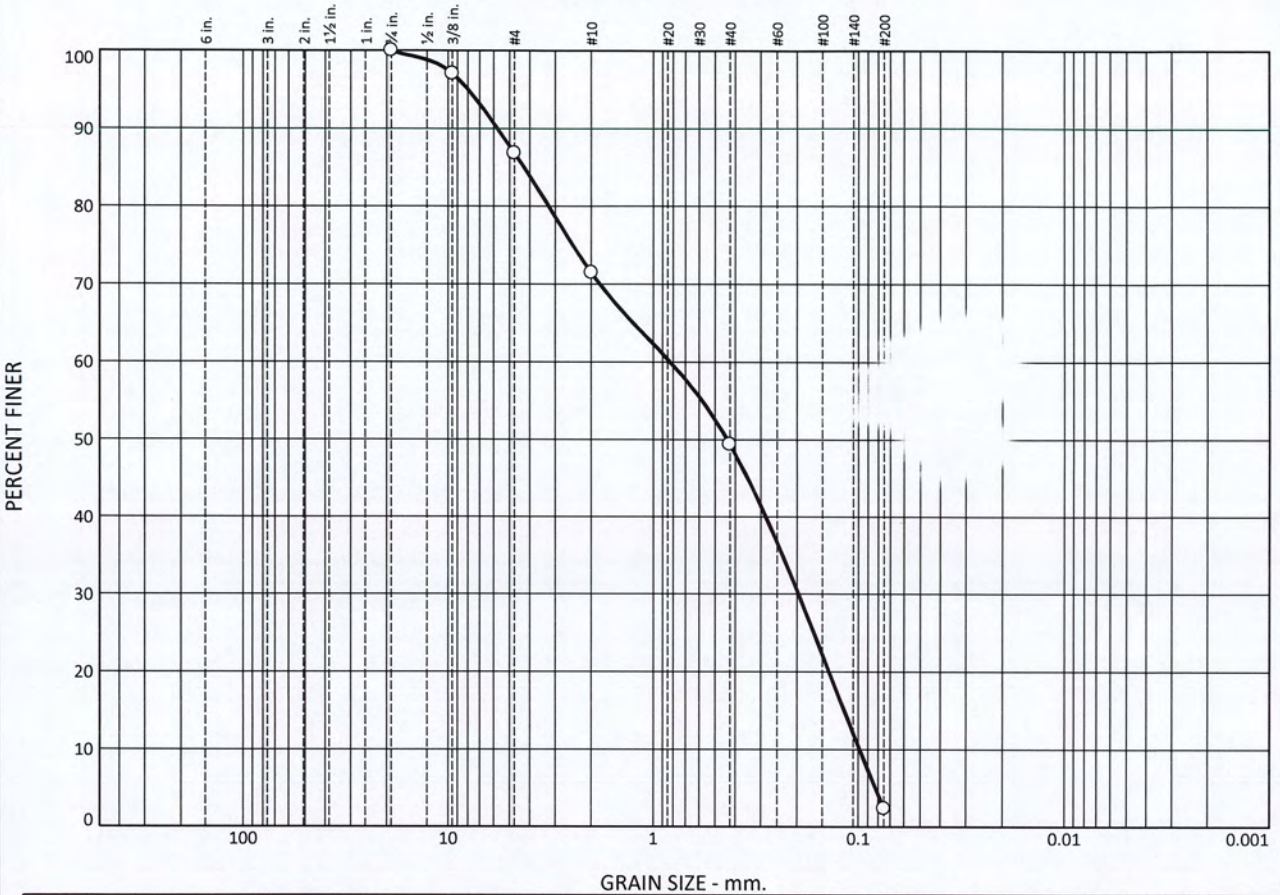
Remarks:

○SAMPLE DESCRIPTION BASED ON USCS

Figure 4

Tested By: JC 09/17/24 **Checked By:** JPB 09/17/24

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	13.1	15.4	22.1	47.0	2.4	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			4.2490	0.8275	0.4373	0.1963	0.1171	0.0985	0.47	8.40

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ GRAY POORLY GRADED SAND	09/17/24	SP	12.4

Project No. 630396 **Client:** REMINGTON & VERNICK ENGINEERS, INC.

Project: NEW PUBLIC WORKS FACILITY, MARGATE, NJ

RVE #0116U200

○ **Source of Sample:** B-3 **Depth:** 35.0-37.0 FT **Sample Number:** S-11

Remarks:

○SAMPLE DESCRIPTION BASED ON USCS

TRC Engineers, Inc.

Mt. Laurel, NJ

Figure 5

Tested By: JC 09/17/24 **Checked By:** JPB 09/17/24

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.1	0.2	4.2	91.3	4.2	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.2853	0.1800	0.1544	0.1146	0.0906	0.0833	0.88	2.16

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ BROWN/GRAY POORLY GRADED SAND	09/17/24	SP	26.2

Project No. 630396 **Client:** REMINGTON & VERNICK ENGINEERS, INC.

Project: NEW PUBLIC WORKS FACILITY, MARGATE, NJ

RVE #0116U200

○ **Source of Sample:** B-4 **Depth:** 20.0-22.0 FT **Sample Number:** S-8

Remarks:

○SAMPLE DESCRIPTION BASED ON USCS

TRC Engineers, Inc.

Mt. Laurel, NJ

Figure 6

Tested By: JC 09/17/24 **Checked By:** JPB 09/17/24

Appendix F

Seismic Information

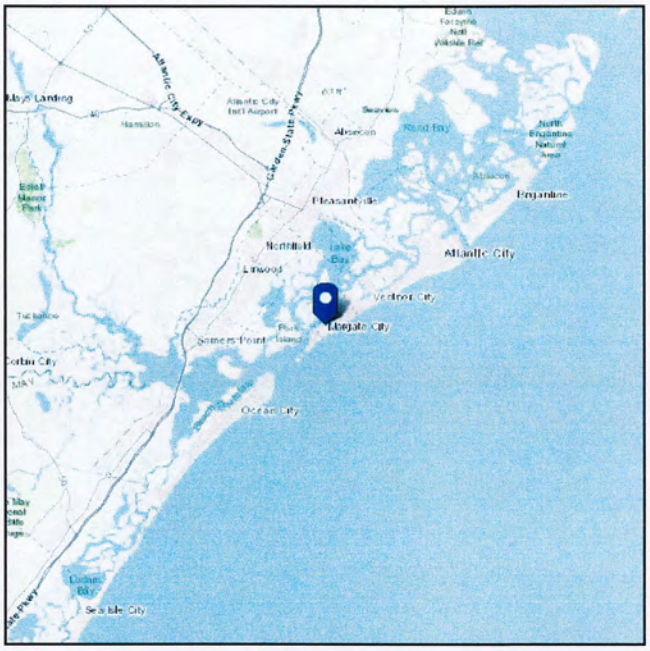
ASCE Hazards Report

Address:
101 N Benson Ave
Margate City, New Jersey
08402

Standard: ASCE/SEI 7-16
Risk Category: IV
Soil Class: D - Stiff Soil

Latitude: 39.32484
Longitude: -74.514307
Elevation: 4.45479575607052 ft (NAVD 88)





ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

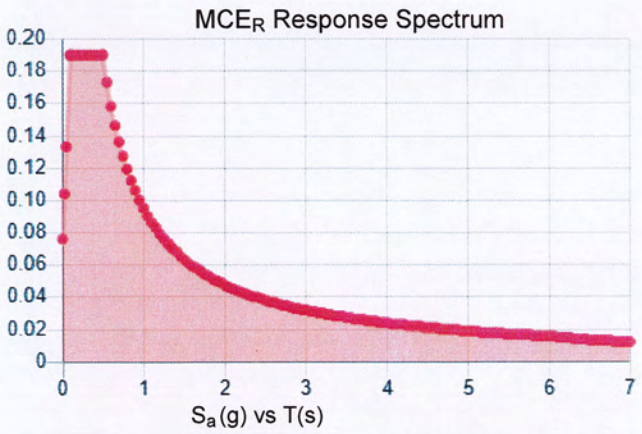
Seismic

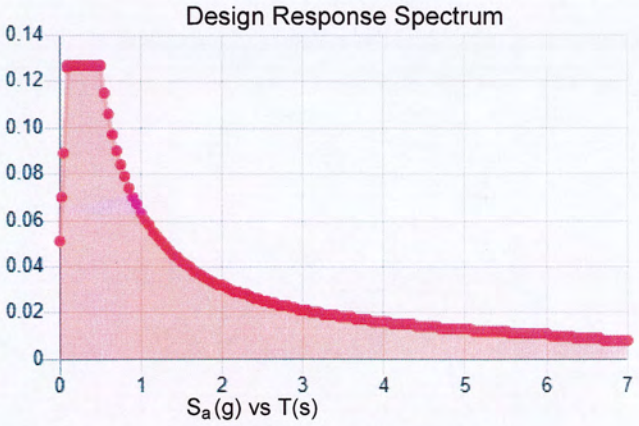
Site Soil Class: D - Stiff Soil

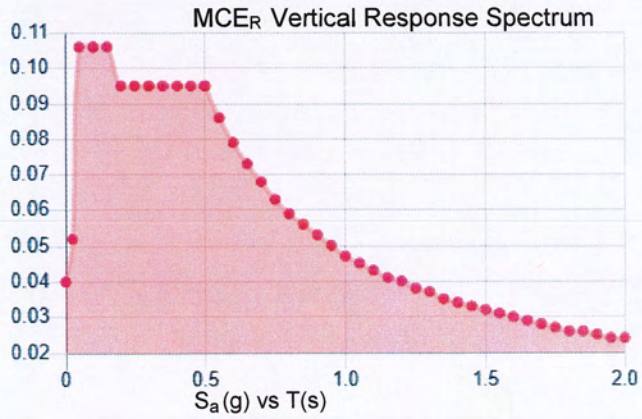
Results:

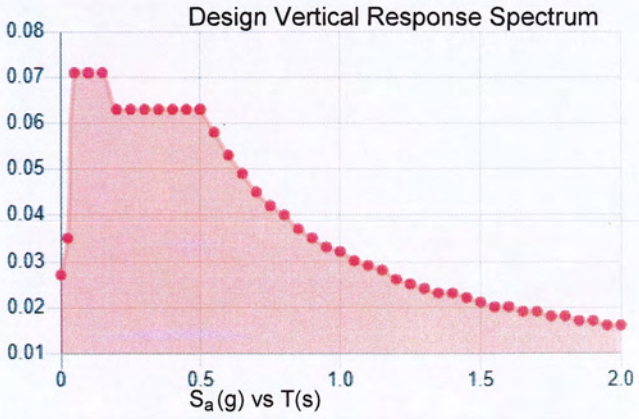
S_S :	0.119	S_{D1} :	0.063
S_1 :	0.04	T_L :	6
F_a :	1.6	PGA :	0.06
F_v :	2.4	PGA_M :	0.096
S_{MS} :	0.19	F_{PGA} :	1.6
S_{M1} :	0.095	I_e :	1.5
S_{DS} :	0.127	C_v :	0.7

Seismic Design Category: A









Data Accessed: **Fri Aug 23 2024**

Date Source:
USGS Seismic Design Maps based on ASCE/SEI 7-16 and ASCE/SEI 7-16 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-16 Ch. 21 are available from USGS.

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APPENDIX C

ORDINANCE NO. 08-2025

AN ORDINANCE AMENDING THE MARGATE CITY MUNICIPAL CODE, CHAPTER 111, CONSTRUCTION, GENERAL REQUIREMENTS, TO PROMOTE CLEAN AND SAFE WORKSITES FOR CONTRACTORS WITHIN THE CITY OF MARGATE CITY

WHEREAS, the City of Margate recognizes the importance of maintaining clean and safe worksites to protect the environment and public health; and

WHEREAS, it is imperative that contractors take measures to minimize the release of dust and plastic contaminants from their worksites, thereby preventing harm to the environment and the community; and

WHEREAS, plastics, composite materials, silica dust from cutting concrete and other man-made materials do not decompose and over time break down to smaller and smaller particles called microplastics. Microplastic pollution disrupts ecosystems and can cause endocrine, digestive, and respiratory issues in animals including humans, and

WHEREAS, the City of Margate seeks to regulate construction practices to ensure compliance with environmentally responsible and safe procedures;

NOW, THEREFORE, BE IT ORDAINED by the City Council of the City of Margate as follows:

Chapter 111, Construction, General Requirements, shall be amended to add the following Article III, Clean and Safe Worksites – Control of Dust and Plastic Contaminants.

Section I: Add

ARTICLE III
CONTROL OF DUST AND PLASTIC CONTAMINANTS

§111-13 1: Definitions

For the purposes of this ordinance, the following definitions apply:

a) "Contractor" refers to any individual or entity engaged in construction, renovation, or related activities within the City of Margate.

b) "Worksites" shall include all locations within the jurisdiction of the City of Margate where construction, renovation, or related activities are taking place.

§111.14: Dust, Trash and Plastic Contaminants Control

Contractors operating within the City of Margate shall adhere to the following guidelines to control dust, trash, silica dust and plastic contaminants at their worksites:

14.1 When cutting or drilling any plastic poly-compound materials, concrete, stone or wood, contractors shall use a vacuum attachment on all saws when practical to minimize the release of dust and micro plastic particles.

14.2 Contractors shall cut and drill in confined spaces to keep dust levels to a minimum and facilitate ease of cleanup.

14.3 Contractors shall not engage in cutting or drilling activities without placing a tarp under power tools to catch debris and contaminants.

14.4 Contractors shall tarp their work areas and clean the area a minimum of once a day to prevent the dispersion of dust and plastic contaminants.

14.5 Contractors shall clean up all wood and plastic contaminants before leaving their worksites, ensuring that no waste is left behind nor can be blown into neighboring properties or the street.

§111.15: Prohibition on Storm Drain Disposal

Contractors are strictly prohibited from blowing debris, dust, or plastic contaminants into storm drains. All contractors must dispose of waste materials properly in accordance with existing municipal waste disposal regulations.

Contractors must separate waste and recyclable materials, such as cardboard, and dispose of in accordance with City ordinances.

§111.16: Compliance and Enforcement

16.1 The City of Margate may conduct inspections of worksites to ensure compliance with this ordinance. Contractors found in violation of this ordinance may be subject to fines and penalties as determined below, per site:

First offense: $150

Second Offense (same site): $300

Third Offense (same site): $500

Fourth Offense (same site): up to $1,000.

16.2 General Contractors are responsible for informing their employees and subcontractors of the requirements and obligations set forth in this ordinance.

Section 2. Effective Date. This ordinance shall take effect ***April 3. 2025*** and shall be applicable to all contractors operating within the City of Margate from that date plus 20 days onward.

Section 3. All ordinances or parts of ordinances inconsistent with any terms of this Ordinance are hereby repealed to the extent of such inconsistency only.

Section 4. This ordinance shall take effect upon its final passage and publication as required by law.

Michael Collins, Mayor

Maury Blumberg, Commissioner

Catherine Horn, Commissioner

Board of Commissioners of the
City of Margate City

Introduced: March 20, 2025
Published: March 27, 2025
Adopted: April 3, 2025
Published: April 10, 2025

APPENDIX D

CONSTRUCTION OF NEW MARGATE CITY PUBLIC WORKS BUILDING

PROJECT LABOR AGREEMENT

ARTICLE 1 – PREAMBLE

WHEREAS, City of Margate City ("Owner") on behalf of itself and Remington & Vernick Engineers, acting as Project Engineer, desires to provide for the efficient, safe, quality, and timely completion of a certain construction project for the Owner known as the Margate City New Public Works Building, located on Block 324.01, Lot 125 Margate, New Jersey (the "Project") in a manner designed to afford reasonable costs and efficiencies to The Owner, and the Public it represents, and the advancement of public policy objectives; and set forth herein; and

WHEREAS, this Project Labor Agreement will foster the achievement of these goals, inter alia by:

- Ensuring a reliable source of skilled and experienced labor;
- Standardizing the terms and conditions governing the employment of labor on the Project;
- Permitting wide flexibility in work scheduling and shift hours and times, from those which otherwise might obtain;
- Receiving negotiated adjustments as to work rules and staffing requirements from those which otherwise might obtain;
- Providing comprehensive and standardized mechanisms for the settlement of work disputes, including those relating to jurisdiction, without delay or disruption to the project;
- Avoiding the costly delays of potential strikes, slowdowns, walkouts, picketing and other disruptions arising from work disputes, and promote labor harmony and peace for the duration of the project;
- Furthering public policy objectives as to improved employment opportunities for minorities, women and the economically disadvantaged in the construction industry;
- Expediting the construction process;
- Stabilizing wages, hours and working conditions for the craft workers on the project; and
- Ensuring a satisfactory, continuous and harmonious relationship between the parties hereto.

WHEREAS, the signatory Unions desire the stability, security and work opportunities afforded by a Project Labor Agreement; and

WHEREAS, the Parties desire to maximize Project safety conditions for both workers and the public.

NOW, THEREFORE, the Parties enter into this Project Labor Agreement pursuant to N.J.S.A. 52:38-1 et seq.

SECTION 1. PARTIES TO THE AGREEMENT

This is a Project Labor Agreement ("Agreement") for a certain construction project at the New Public Works Building in Margate City, New Jersey. This Agreement is entered into by and between the Owner and its successors and assigns, and the Contractor(s) to be named (such Contractors joining by Letters of Assent in the form of Schedule B attached), and by the South Jersey Building and Construction Trades Council, ("BTC") on behalf of itself and its affiliated local union members, (each a "local Union", and collectively "Member Unions") and sometimes referred to herein where the context requires as a "Local Union", and together with the Member Unions, the "Unions") for certain construction work to be performed as outlined under Article 3.

ARTICLE 2 – GENERAL CONDITIONS

SECTION 1. DEFINITIONS

Throughout this Agreement, the South Jersey Building and Construction Trades Council shall be referred to as "BTC", the BTC's Member Unions are referred to singularly and collectively as "the Union(s)," and where specific reference is made to "Local Unions" that phrase is sometimes used; the term "Contractor(s) or Employer(s)" shall include all signatory Contractors, and their subcontractors of whatever tier, engaged in on-site Project construction work within the scope of this Agreement as defined in Article 3; the City of Margate is referenced as ("Margate") or ("Owner"); the South Jersey Building and Construction Trades Council is referenced as the ("BTC"), the Project Engineer and Owner's Representative, Remington & Vernick Engineers, is referenced as "PENG", or "Project Engineer" and the work covered by this Agreement (as defined in Article 3) is referred to as the "Project".

SECTION 2. CONDITIONS FOR AGREEMENT TO BECOME EFFECTIVE

The Agreement shall not become effective unless executed by all parties designated in Article 1, Section 1 above, and will remain in effect until the completion of the Project. In the event that the Owner opts not to use a Project Engineer, in the Owner's sole discretion, then the Owner shall designate an Owner's representative who shall act, under the terms of this Agreement, as a Project Engineer.

SECTION 3. ENTITIES BOUND & ADMINISTRATION OF AGREEMENT

This Agreement shall be binding on the BTC, all signatory Unions and the Owner and all signatory Contractors performing on-site Project work, including site preparation and staging areas, as defined in Article 3. The Contractors shall include in any subcontract that they enter into for Project Work, for performance during the term of this Agreement, a requirement that their subcontractors, of whatever tier, become signatories and bound by this Agreement with respect to subcontracted work performed within the scope of Article 3, and as per Schedule A "Local Collective Bargaining Agreements" and per Schedule B "Contractors Letters of Assent".

SECTION 4. SUPREMACY CLAUSE

This Agreement, together with the local Collective Bargaining Agreements appended hereto as Schedule A and Contractor(s) Letters of Assent appended hereto as Schedule B, represents the complete understanding of all signatories and supersedes any national agreement, local agreement or other collective bargaining agreement of any type which would otherwise apply to this Project, in whole or in part, except for all work performed under the National Agreement of the International Union of Elevator Constructors, with the exception of Article VII, IX and X of this Agreement. Where a subject covered by the provisions, explicit or implicit, of this Agreement is also covered by a Schedule A, the provisions of this Agreement shall prevail except for all work performed under the NTD Articles of Agreement, the National Stack/Chimney Agreement, the National Cooling Tower Agreement, all instrument calibration work and loop checking shall be performed under the terms of the UA/IBEW Joint National Agreement for Instrument and Control Systems Technicians, and the National Agreement of the International Union of Elevator Constructors, with the exception of Article 7, 9 and 10 of this Agreement, all such work will be governed by the National Agreement. No practice, understanding or agreement between a Contractor and Local Union, which is not explicitly set forth in this Agreement, shall be binding on this Project. It is further understood that no contractor shall be required to sign any other agreement as a condition of performing work on this project. No practice, understanding or agreement between a Contractor and Local Union, which is not explicitly set forth in this Agreement, shall apply on this Project.

SECTION 5. LIABILITY

The liability of any Contractor and the liability of any Union under this Agreement shall be several and not joint. The Owner, PENG and any Contractor shall not be liable for any violations of this Agreement by any other Contractor, and the BTC and Local Unions shall not be liable for any violations of this Agreement by any other Union.

SECTION 6. AWARD OF CONTRACTS AND SUSPENSION OF WORK

The Owner shall require in its bid specifications for all work within the scope of Article 3 that all successful bidders, and their subcontractors of whatever tier, become bound by, and signatory to, this Agreement. It is understood that nothing in this Agreement shall be construed as limiting the sole discretions of the Owner in determining which Contractors shall be awarded contracts for Project Work. It is further understood that the Owner has sole discretion at any time to terminate, delay or suspend the work, in whole or part, on this Project.

SECTION 7. BID SPECIFICATIONS

The Owner shall include in all bid specifications for the construction project at Margate Public Works Building a notice advising all bidders that the work is subject to this Agreement and that all Contractors and subcontractors will be required to provide the Schedule B "Contractors Letters of Assent" as a condition of any contract award. It is understood that nothing in this Agreement shall be construed as limiting the sole discretion of the Owner in the award of contracts

for work on the Project; nor shall it limit the rights of the Owner and/or Contractors in determining which subcontractor(s) shall be awarded subcontracts for Project work.

SECTION 8. THE PROJECT ENGINEER

The Owner has retained Remington & Vernick Engineers as the Project Engineer ("PENG" or "Project Engineer") and Owner's Representative. All references herein to the Project Engineer shall also be to the Owner and all notices required to be given to the Project Engineer under this Agreement shall also be given to the Owner.

SECTION 9. AVAILABILITY AND APPLICABILITY TO ALL SUCCESSFUL BIDDERS

A. The Owner shall require in its bid specifications for all work within the scope of Article 3 that all successful bidders, and their subcontractors of whatever tier, become bound by, and signatory to, this Agreement. It is understood that nothing in this Agreement shall be construed as limiting the sole discretion of the Owner or the Project Engineer on behalf of the Owner in determining which Contractors shall be awarded contracts for Project work. It is further understood that the Owner has the sole discretion at any time to terminate, delay or suspend the work, in whole or in part, on this Project.

B. The Unions agree that this Agreement will be made available to, and will fully apply to any successful bidder for the Project work who becomes signatory thereto, without regard to whether that successful bidder performs work at other sites on either a union or non-union basis and without regard to whether employees of such successful bidder are, or are not, members of any unions. This Agreement shall not apply to the work of any Contractor which is performed at any location other than the Project site, as defined in Article 3, Section 1.

ARTICLE 3 – SCOPE OF THE AGREEMENT

The Project work covered by this Agreement shall be as defined and limited by the following sections of this Article.

SECTION 1. THE WORK

This Agreement only applies to the construction of all on-site work at the Project, as defined in the prime contract awarded by the Owner to the General Contractor, as executed between them, with respect to a Project to be undertaken at Margate Public Works Building.

This Scope of Work may be amended from time to time by the Owner to include work not performed under the original contract bid documents. The Scope of Work is confined to the on-site Project performed work contained in the scope of the General Contractor's final construction contract. In no event shall this Agreement be construed to apply to any other construction activity engaged in by the Owner, directly or indirectly or by a vendor or tenant of the Owner, at or in the vicinity of the Project site.

A summarized scope of work is attached herewith as Schedule C.

The scope of work may be amended time to time by the Owner to include work not included under this description.

SECTION 2. EXCLUDED EMPLOYEES

The following persons are not subject to the provisions of this Agreement, even though performing work on the Project:

A. Superintendents, supervisors (excluding superintendents and general supervisors and forepersons specifically covered by a craft's Schedule A), engineers, architects, inspectors and testers (excluding divers specifically covered by a craft's Schedule A), quality control/assurance personnel, timekeepers, mail carriers, clerks, office workers, messengers, guards, non-manual employees, and all professional, engineering, administrative and management persons;

B. Employees of the Owner or any State agency, authority or entity or employees of any municipality or other public employer;

C. Employees of any Project Engineer or consultant engaged by the Owner, excepting those who are performing manual, on-site construction labor who will be covered by this Agreement;

D. Employees and entities engaged in off-site manufacture, modifications, repair, maintenance, assembly, painting, handling or fabrication of project components, materials, equipment or machinery, unless such offsite operations are covered by the New Jersey Prevailing Wage Act by being dedicated exclusively to the performance of the public works contract or building project and are adjacent to the site of work, or involved in deliveries to and from the Project site, excepting local deliveries of all major construction materials including, but not limited to, fill, ready mix, and asphalt which are covered by this Agreement;

E. Employees of the Contractors, excepting those performing manual, on-site construction labor covered by this Agreement;

F. Employees engaged in on-site equipment warranty work;

G. Employees engaged in geophysical testing (whether land or water) other than boring for core samples;

H. Employees engaged in laboratory or specialty testing or inspections; and

I. Employees engaged in ancillary Project work performed by third parties such as electric utilities, gas utilities, telephone utility companies, and railroads;

SECTION 3. NON-APPLICATION TO CERTAIN ENTITIES

This Agreement shall not apply to the parents, affiliates, subsidiaries, or other joint or sole ventures of the Owner, the Project Engineer, or any Contractors which do not perform work at this Project Site. It is agreed, for the purposes of this Agreement only, that this Agreement does not have the effect of creating any joint employment, single employer or alter ego status between the Owner, the Project Engineer and/or any Contractor. The Agreement shall further not apply to the Owner, its Project Management firm, Clerk of the Works, or any other state or county agency, authority, or other municipal or public entity, and nothing contained herein shall be construed to prohibit or restrict the Owner or its employees, or the employees of any other state authority, agency or entity from performing on or off-site work related to the Project. As the contracts which comprise the Project work are completed and accepted, the Agreement shall not have further force or effect on such items or areas except where inspections, additions, repairs, modifications, check-out and/or warranty work are assigned in writing (copy to Local Union involved) to the Contractor(s) for performance under the terms of this Agreement and per Schedule B - "Contractors Letters of Assent."

ARTICLE 4 – UNION RECOGNITION AND EMPLOYMENT

SECTION 1. PRE-HIRE RECOGNITION

The Contractors recognize the signatory Unions as the sole and exclusive bargaining representatives of all craft employees who are performing on-site Project work within the scope of this Agreement as defined in Article 3.

SECTION 2. UNION REFERRAL

A. The Contractors agree to hire Project craft employees covered by this Agreement through the job referral systems and hiring halls (where the referrals meet the qualifications set forth in items 1, 2, and 4 subparagraph B) established in the Local Unions' area collective bargaining agreements (attached as Schedule A to this Agreement). Notwithstanding this, the Contractors shall have sole rights to determine the competency of all referrals; the number of employees required (except with regard to pile-driving); the selection of employees to be laid-off (subject to the applicable procedures in Schedule A for permanent and/or temporary layoffs and except as provided in Article 5, Section 3); and the sole right to reject any applicant referred by a Local Union, subject to the show-up payments required in the applicable Schedule A. In the event that a Local Union is unable to fill any request for qualified employees within a 48-hour period after such requisition is made by the Contractor (Saturdays, Sundays and holidays excepted), the Contractor may employ qualified applicants from another competent source. In the event that the Local Union does not have a job referral system, the Contractor shall give the Local Union first preference to refer applicants, subject to the other provisions of this Article. The Contractor shall notify the Local Union of the Project, craft employees hired within its jurisdiction from any source other than referral by the Union.

B. Following the employment of the first employee in each craft under Schedule A or the procedure set forth above in paragraph A, a Contractor may request by name, and the Local Union will honor, referral of persons who have applied to the Local Union for Project work and who meet the following qualifications as determined by a Committee of 3 designated, respectively, by the applicable Local Union, the Owner and a mutually selected third party or, in the absence of agreement, the permanent arbitrator (or designee) designated in Article 7:

1) Possess any license required by New Jersey law for the Project work to be performed;

2) Have worked a total of at least 1,000 hours in the Construction craft during the prior 3 years;

3) Were on the Contractor's active payroll for at least 60 out of the 180 calendar days prior to the contract award; and

4) Have demonstrated ability to safely perform the basic functions of the applicable trade.

No more than 12 per centum of the employees covered by this Agreement, per Contractor by craft, shall be hired through the special provisions above (any fraction shall be rounded to the next highest whole number).

A certified MBE/WBE contractor may request from the Workforce Coordinator, through the Owner, an exception to, and waiver of, the above per centum limitation upon the number of its employees to be hired through the special provision of Section 2(b) above. This exception is based upon hardship and demonstration by the Contractor that the Project work would be the Contractor's only job and that it would be obliged to lay off qualified minority and female employees in its current workforce moving from the last job. The exception and waiver are also conditioned upon the employees meeting the qualifications as set forth in Section 2(b), above.

SECTION 3. NON-DISCRIMINATION IN REFERRALS

The Unions represent that their hiring halls and referral systems will be operated in a non-discriminatory manner and in full compliance with all applicable federal, state and local laws and regulations, which require equal employment opportunities. Referrals shall not be affected in any way by the rules, regulations, bylaws, constitutional provisions or any other aspects or obligations of union membership, policies or requirements and shall be subject to such other conditions as are established in this Article. No employment applicant shall be discriminated against by any referral system or hiring hall because of the applicant's union membership, or lack thereof.

SECTION 4. MINORITY AND FEMALE REFERRALS

In the event a Union either fails, or is unable, to refer qualified minority or female applicants in percentages equaling Project affirmative action goals as set forth in the Owner's bid specifications, the Contractor may employ qualified minority or female applicants from any other available source as Apprentice Equivalents. Apprentice Equivalents will have completed a Department of Labor ("DOL") approved training program, applied to take a construction Apprenticeship test, and will be paid at not less than the applicable equivalent Apprentice rate. With the approval of the Local Administrative Committee (LAC), experience in construction related areas may be accepted as meeting the above requirements.

SECTION 5. CROSS AND QUALIFIED REFERRALS

The Unions shall not knowingly refer to a Contractor an employee then employed by another Contractor working under this Agreement. The Local Unions will exert their utmost efforts to recruit sufficient numbers of skilled and qualified craft employees to fulfill the requirements of the Contractor.

SECTION 6. UNION DUES/WORKING ASSESSMENTS

All employees covered by this Agreement shall be subject to the union security provisions contained in the applicable Schedule A local agreements, as amended from time to time, but only for the period of time during which they are performing on-site Project work and only to the extent of rendering payment of the applicable union dues and assessments uniformly required for union membership in the Local Union, signatory to this Agreement, which represents the craft in which the employee is performing Project work. No employee shall be discriminated against at the Project site because of the employee's union membership or lack thereof. In the case of unaffiliated employees, the dues payment can be received by the Unions as a working assessment fee.

SECTION 7. CRAFT FOREPERSONS AND GENERAL FOREPERSONS

The selection of craft forepersons and/or general forepersons and the number of forepersons required shall be solely the responsibility of the Contractor except where otherwise provided by specific provisions of an applicable Schedule A collective bargaining agreement. All forepersons shall take orders exclusively from the designated Contractor representatives. Craft forepersons shall be designated as working forepersons at the request of the Contractor, except when an existing local Collective Bargaining Agreement prohibits a foreperson from working when the crafts-persons he is leading exceed a specified number.

ARTICLE 5 – UNION REPRESENTATIONS

SECTION 1. LOCAL UNION REPRESENTATIVE

Each Local Union representing on-site Project employees shall be entitled to designate in writing (with copies to the Contractors involved and the Owner and Project Management Firm)

one representative, and the Business Manager, who shall be afforded access to the Project. Such representatives shall fully comply with the visitor, safety and security of the Project.

SECTION 2. STEWARDS

A) Each Local Union shall have the right to designate a working journey person as a Steward and an alternate, and shall notify the Contractor and PENG of the identity of the designated Steward (and alternate) prior to the assumption of such duties. Stewards shall not exercise supervisory functions and will receive the regular rate of pay for their craft classifications. There will be no non-working Stewards on the Project.

B) In addition to their work as an employee, the Steward shall have the right to receive complaints or grievances and to discuss and assist in their adjustment with the Contractor's appropriate supervisor. Each Steward shall be concerned with the employees of the Steward's Contractor and, if applicable, subcontractors of that Contractor, but not with the employees of any other Contractor. The Contractor will not discriminate against the Steward in the proper performance of Union duties.

C) The Steward shall not have the right to determine when overtime shall be worked, or who shall work overtime, except pursuant to a Schedule A provision providing procedures for the equitable distribution of overtime.

SECTION 3. LAYOFF OF A STEWARD

Contractors agree to notify the appropriate Union 24 hours prior to the layoff of a Steward, except in cases of discipline or discharge for just cause. If a Steward is protected against layoff by a Schedule A, such provisions shall be recognized to the extent the Steward possesses the necessary qualifications to perform the work required. In any case in which a Steward is discharged or disciplined for just cause, the Local Union involved shall be notified immediately by the Contractor.

ARTICLE 6 – MANAGEMENT'S RIGHTS

SECTION 1. RESERVATION OF RIGHTS

Except as expressly limited by a specific provision of this Agreement, Contractors retain full and exclusive authority for the management of their Project operations including, but not limited to: the right to direct the work force, including determination as to the number to be hired and the qualifications therefore; the promotion, transfer, layoff of its employees; or the discipline or discharge for just cause of its employees; the assignment and schedule of work; the promulgation of reasonable Project work rules; and, the requirement, timing and number of employees to be utilized for overtime work. No rules, customs, or practices, which limit or restrict productivity or efficiency of the individual, as determined by the Contractors and/or joint working efforts with other employees shall be permitted or observed.

SECTION 2. MATERIALS, METHODS & EQUIPMENT

There shall be no limitations or restriction upon the Contractors choice of materials, techniques, methods, technology or design, or, regardless of source or location, upon the use and installation of equipment, machinery, package units, pre-cast, pre-fabricated, pre-finished, or pre-assembled materials, tool, or other labor-saving devices. Contractors may, without restriction, install or use materials, supplies or equipment regardless of their source. The on-site installation or application of such items shall be performed by the craft having jurisdiction over such work; provided, however, it is recognized that other personnel having special qualifications may participate, in a supervisory capacity, in the installation, check-out or testing of specialized or unusual equipment or facilities as designated by the Contractor. Notwithstanding the foregoing statement of contractor rights, prefabrication issues relating to work traditionally performed at the job site shall be governed pursuant to the terms of the applicable Schedule A. There shall be no restrictions as to work, which is performed off-site for the Projects, except for work done in a fabrication center, tool yard, or batch plant dedicated exclusively to the performance of work on the Project, and located adjacent to the "site of work".

ARTICLE 7 – WORK STOPPAGES AND LOCKOUTS

SECTION 1. NO STRIKES-NO LOCKOUT

There shall not be strikes, sympathy strikes, picketing, work stoppages, slowdowns, hand billing, demonstrations or other disruptive activity at the Project for any reason by any Union or employee against any Contractor or employer while performing work at the Project. There shall be no other Union, or concerted or employee activity which disrupts or interferes with the operation of the existing free flow of traffic in the project area. Failure of any Union or employee to cross any picket line established by any union, signatory or non-signatory to this Agreement, or the picket or demonstration line of any other organization, at or in proximity to the Project site is a violation of this Article. There shall be no lockout at the Project by any signatory Contractor. Contractors and Unions shall take all steps necessary to ensure compliance with this Section 1 and to ensure uninterrupted construction and the free flow of traffic in the project area for the duration of this Agreement.

SECTION 2. DISCHARGE FOR VIOLATION

A Contractor may discharge any employee violating Section 1, above, and any such employee will not be eligible thereafter.

SECTION 3. NOTIFICATION

If a Contractor contends that any Union has violated this Article, it will notify the appropriate district or area council of the Local Union involved advising of such fact, with copies of the notification to the Local Unions and South Jersey Building and Construction Trades Council ("BTC"). The district or area council, and the BTC shall each instruct, order and otherwise use their best efforts to cause the employees, and/or Local Unions to immediately cease and desist from any violation of this Article. A district or area council, or the BTC

complying with these obligations shall not be liable for the unauthorized acts of a Local Union or its members.

SECTION 4. EXPEDITED ARBITRATION

Any Contractor or Union alleging a violation of Section 1 of this Article may utilize the expedited procedure set forth below (in lieu of, or in addition to, any actions at law or equity) that may be brought.

A. A party invoking this procedure shall notify JJ Pierson, Jr., Esq., The Arbitration Centre, 8 Fox Hunt Road, Box 604, New Vernon, NJ 07976, phone 973-359-8100, fax 973-359-8161 who shall serve as Arbitrator under this expedited arbitration procedure. Copies of such notification will be simultaneously sent to the alleged violator and, if a Local Union is alleged to be in violation, its International, the Owner, the PENG, the BTC, and the Contractor involved.

B. The Arbitrator shall thereupon, after notice as to the time and place to the Contractor, the Local Union involved, the BTC, and the PENG, hold a hearing within 48 hours of receipt of the notice invoking the procedure if it is contended that the violation still exists. The hearing will not, however, be scheduled for less than 24 hours after the notice to the Owner or area council required by Section 3 above.

C. All notices pursuant to this Article may be by telephone, telegraph, hand delivery, or fax, confirmed by overnight delivery, to the arbitrator, Contractor or Union involved. The hearing may be held on any day including Saturdays or Sundays. The hearing shall be completed in one session, which shall not exceed 8 hours duration (no more than 4 hours being allowed to either side to present their case, and conduct their cross examination) unless otherwise agreed. A failure of any Union or Contractor to attend the hearing shall not delay the hearing of evidence by those present or the issuance of an award by the Arbitrator.

D. The sole issue at the hearing shall be whether a violation of Section 1, above, occurred. If a violation is found to have occurred, the Arbitrator shall issues a Cease and Desist Award restraining such violation and serve copies on the Contractor and Union involved. The Arbitrator shall have no authority to consider any matter in justification, explanation or mitigation of such violation or to award damages, which issue is reserved solely for court proceedings, if any. The Award shall be issued in writing within 3 hours after the close of the hearing, and may be issued without an Opinion. If any involved party desires an Opinion, one shall be issued within 15 calendar days, but its issuance shall not delay compliance with, or enforcement of, the Award.

E. An Award issued under this procedure may be enforced by any court of competent jurisdiction upon the filing of the Agreement together with the Award. Notice of the filing of such enforcement proceedings shall be given to the Union or Contractor involved. In any court proceeding to obtain a temporary or preliminary order

enforcing the arbitrator's Award as issued under this expedited procedure, the involved Union and Contractor waive their right to a hearing and agree that such proceedings may be ex parte, provided notice is given to opposing counsel. Such agreement does not waive any party's right to participate in a hearing for a final court order of enforcement or in any contempt proceeding.

F. Any rights created by statute or law governing arbitration proceedings which are inconsistent with the procedure set forth in this Article, or which interfere with compliance thereto, are hereby waived by the Contractors and Unions to whom they accrue.

G. The fees and expenses of the Arbitrator shall be equally divided between the involved Contractor and Union.

SECTION 5. ARBITRATION OF DISCHARGES FOR VIOLATION

Procedures contained in Article 9 shall not be applicable to any alleged violation of this Article, with the single exception that an employee discharged for violation of Section 1, above, may have recourse to the procedures of Article 9 to determine only if the employee did, in fact, violate the provisions of Section 1 of this Article; but not for the purpose of modifying the discipline imposed where a violation is found to have occurred.

ARTICLE 8. – LOCAL ADMINISTRATIVE COMMITTEE (LAC)

SECTION 1. THE LOCAL ADMINISTRATIVE COMMITTEE

The Local Administrative Committee (LAC) will meet on a regular basis to:

A. Implement and oversee this Agreement's procedures and initiatives;

B. Monitor the effectiveness of this Agreement; and

C. Identify opportunities to improve efficiency and work execution.

SECTION 2. COMPOSITION

The LAC will be co-chaired by the President of the BTC or his designee, and a designated official of the Owner. It will be comprised of representatives of the local unions signatory to this Agreement and representatives of the Owner's Project Management firm and other contractors on the Project.

ARTICLE 9. – GRIEVANCE AND ARBITRATION PROCEDURE

SECTION 1. PROCEDURE FOR RESOLUTION OF GRIEVANCES

Any question, dispute or claim arising out of, or involving the interpretation or application of this Agreement (other than jurisdictional disputes or alleged violation of Article 7, Section 1) shall be considered a grievance and shall be resolved pursuant to the exclusive procedure of the steps described below; provided, in all cases, that the question, dispute or claim arose during the term of this Agreement.

Step 1:

A. When any employee covered by this Agreement feels aggrieved by a claimed violation of this Agreement, the employee shall, through the Local Union business representative or job steward give notice of the claimed violation to the work site representative of the involved Contractor. To be timely, such notice of the grievance must be given within 7 calendar days after the act, occurrence, or event giving rise to the grievance, or after the act, occurrence or event became known or should have become known to the Union. The business representative of the Local Union or the job steward and the work site representative of the involved Contractor shall meet and endeavor to adjust the matter within 7 calendar days after timely notice has been given. If they fail to resolve the matter within the prescribed period, the grieving party, may, within seven (7) calendar days thereafter, pursue Step 2 of the grievance procedure by serving the involved Contractor with written copies of the grievance setting forth a description of the claimed violation, the date on which the grievance occurred, and the provisions of the Agreement alleged to have been violated. Grievances and disputes settled at Step 1 are non-precedential except as to the specific Local Union, employee and Contractor directly involved, unless the settlement is accepted in writing, by the Contractor, as creating a precedent.

B. Should any signatory to this Agreement have a dispute (excepting jurisdictional disputes or alleged violations of Article 7, Section 1) with any other signatory to this Agreement and, if after conferring, a settlement is not reached within 7 calendar days, the dispute shall be reduced to writing and proceed to Step 2 in the same manner as outlined in sub-paragraph (a) for the adjustment of grievances on behalf of employees.

Step 2:

The Business Manager or designee of the involved Local Union, together with representatives of the BTC and the involved Contractor, shall meet in Step 2 within 5 calendar days of the written grievance to arrive at a satisfactory settlement.

Step 3:

A. If the grievance shall have been submitted but not resolved in Step 2, any of the participating Step 2 entities may, within fourteen (14) calendar days after the initial

Step 2 meeting, submit the grievance in writing (with copies to other participants) to the next available arbitrator of the panel of Arbitrators consisting of Arbitrator JJ Pierson, Gary Kendellen, and Wellington Davis, who shall act as the Arbitrator under this procedure. The Labor Arbitration Rules of the American Arbitration Association shall govern the conduct of the arbitration hearing, at which all Step 2 participants shall be parties. The decision of the Arbitrator shall be final and binding on the involved Contractor, Local Union and employees. The fees and expenses of such arbitration shall be borne equally by the involved Contractor and Local Union.

B. Failure of the grieving party to adhere to the time limits set forth in this Article shall render the grievance null and void. These time limits may be extended only by written consent of the PENG, involved Contractor and involved Local Union at the particular step where the extension is agreed upon. The Arbitrator shall have authority to make decisions only on the issues presented to him and shall not have the authority to change, add to, delete or modify any provision of this Agreement.

SECTION 2. LIMITATION AS TO RETROACTIVITY

No arbitration decision or award may provide retroactivity of any kind exceeding thirty (30) calendar days prior to the date of service of the written grievance on the Project Engineer, the Owner and the involved Contractor or Local Union.

SECTION 3. PARTICIPATION BY PROJECT ENGINEER

The Project Engineer shall be notified by the involved Contractor of all actions at Steps 2 and 3 and, at its election, may participate on behalf of the Owner in full in all proceedings at these Steps, including Step 3 arbitration.

ARTICLE 10 – JURISDICTIONAL DISPUTES

SECTION 1. NO DISRUPTIONS

There will be no strikes, sympathy strikes, work stoppages, slowdowns, picketing or other disruptive activity of any kind arising out of any jurisdictional dispute. Pending the resolution of the dispute, the work shall continue uninterrupted and as assigned by the Contractor. No jurisdictional dispute shall excuse a violation of Article 7.

SECTION 2. ASSIGNMENT

A. There shall be a mandatory pre-job markup/assignment meeting prior to the commencement of any work. Attending such meeting shall be designated representatives of the Union signatories to this Agreement, the PENG, and the involved Contractors. Best efforts will be made to schedule the pre-job meeting in a timely manner after Notice to Proceed is issued but not later than 30 days prior to the start of the Project.

B. All project construction work assignments shall be made by the Contractor according to the criteria set forth in Article 10, Section 3(D)(1) – (3).

C. When a Contractor has made an assignment of work, he shall continue the assignment without alternation unless otherwise directed by an arbitrator or there is an agreement between the National or International Unions involved. Claims of a change of assignment shall be processed in accordance with Article 1 of the Procedural Rules of the Plan for the Settlement of Jurisdictional Disputes in the Construction Industry ("the Plan").

D. In the event that a Union involved in the change of original assignment dispute is an affiliate of a National or International Union that is not affiliated with the Building and Construction Trades Department and does not wish to process a case through the Plan, the parties shall mutually select one of the following Arbitrators: Arbitrator JJ Pierson, Arbitrator Gary Kendellen, or Arbitrator Wellington Davis, and submit the dispute directly to the Arbitrator. The selected Arbitrator shall determine whether the case requires a hearing or may be decided upon written submission. In rendering his determination on whether there has been a change of original assignment, the Arbitrator shall be governed by the following:

    1) The Contractor who has the responsibility for the performance and installation shall make a specific assignment of the work which is included in his contract to a particular union(s). For instance, if Contractor A subcontracts certain work to Contractor B, then Contractor B shall have the responsibility for making the specific assignments for the work included in his contract. If Contractor B, in turn, shall subcontract certain work to Contractor C, then Contractor C shall have the responsibility for making the specific assignment for the work included in his contract. After work has been so assigned, each assignment will be maintained even though the assigning Contractor is replaced and such work is subcontracted to another Contractor. It is a violation of the Agreement for the Contractor to hold up disputed work or shut down a project because of a jurisdictional dispute.

    2) When a Contractor has made an assignment of work, he shall continue the assignment without alteration unless otherwise directed by an Arbitrator or there is an agreement between the National or International Unions involved.

        a. Unloading and/or handling of materials to stockpile or storage by a trade for the convenience of the responsible Contractor when his employees are not on the job site, or in an emergency situation, shall not be considered to be an original assignment to that trade.

        b. Starting of work by a trade without a specific assignment by an authorized representative of the responsible Contractor shall not

be considered an original assignment to that trade, provided that the responsible Contractor, or his authorized representative, promptly, and in any event, within eight (8) working hours following the start of the work, takes positive steps to stop further unauthorized performance of the work by that trade.

SECTION 3. PROCEDURE FOR SETTLEMENT OF DISPUTES

A. Any Union having a jurisdictional dispute with respect to Project work assigned to another Union will submit through its International the dispute in writing to the Administrator of the Plan within 72 hours and send a copy of the letter to the other Union involved, the Contractor involved, the General Contractor, the BTC, and the district or area councils of the unions involved. Upon receipt of a dispute letter from any union, the Administrator will invoke the procedures set forth in the Plan to resolve the jurisdictional dispute. The jurisdictional dispute letter shall contain the information described in Article IV of the Procedural Rules of the Plan.

B. Within five (5) calendar days of receipt of the dispute letter, there shall be meeting of the General Contractor, the Contractor involved, the Local Unions involved and designees of the BTC and the district or area councils of the Local Unions involved for the purpose of resolving the jurisdictional dispute.

C. In order to expedite the resolution of jurisdictional disputes, the parties have agreed in advance to mutually select one of the following designated Arbitrators: Arbitrator JJ Pierson, Arbitrator Andy Douglas or Arbitrator Richard K. Henft to hear all unresolved jurisdictional disputes arising under this Agreement. All other rules and procedures of the Plan shall be followed. If none of the three Arbitrators is not available to hear the dispute within the time limits of the Plan, the Plan's arbitrator selection process shall be utilized to select another arbitrator.

D. In the event that a Union involved in the dispute is an affiliate of a National or International Union that is not affiliated with the National Building and Construction Trades Council and does not wish to process cases through the Plan as described in paragraphs A-C above, the parties to the dispute shall mutually select one of the following Arbitrators: Arbitrator JJ Pierson, Arbitrator Gary Kendellen, or Arbitrator Wellington Davis to hear the dispute and shall submit the dispute directly to the selected arbitrator. The time limits for submission and processing disputes shall be the same as provided elsewhere in this Section. The selected Arbitrator shall schedule the hearing within seven (7) business days from the date of submission. If he cannot hear the case within the required timeframe, one of the other Arbitrators will be selected to hear the case unless all parties to the dispute agree to waive the seven (7) day time limit. In rendering his decision, the Arbitrator shall determine:

    1) First whether a previous agreement of record or applicable agreement, including a disclaimer agreement, between the National and International Unions to the dispute governs;

2) Only if the Arbitrator finds that the dispute is not covered by an appropriate or applicable agreement of record or agreement between the crafts to the dispute, he shall then consider the established trade practice in the industry and prevailing practice in the locality where there is a previous decision of record governing the case, the Arbitrator shall give equal weight to such decision of record, unless the prevailing practice in the locality in the past ten (10) years favors one craft. In that case, the Arbitrator shall base his decision on the prevailing practice in the locality. Except, that if the Arbitrator finds that a craft has improperly obtained the prevailing practice in the locality through raiding, the undercutting of wages or by the use of vertical agreements, the Arbitrator shall rely on the decision of record and established trade practice in the industry rather than the prevailing practice in the locality.

3) Only if none of the criteria is found to exist, the Arbitrator shall then consider that because of efficiency, cost or continuity and good management are essential to the wellbeing of the industry, the interest of the consumer or the past practices of the employer shall not be ignored. The Arbitrator shall set forth the basis of his decision and shall explain his findings regarding the applicability of the above criteria. If lower-ranked criteria are relied upon, the Arbitrator shall explain why the higher- ranked criteria were not deemed applicable. The Arbitrator's decision shall apply to the job in dispute.

Each party to the arbitration shall bear its own expense for the arbitration and agrees that the fees and expenses of the Arbitrator shall be borne by the losing party or parties as determined by the Arbitrator.

E. The Arbitrator shall render a short-form decision within five (5) days of the hearing based upon the evidence submitted at the hearing, with a written decision to follow within thirty (30) days of the close of hearing.

F. This Jurisdictional Dispute Resolution Procedure will only apply to work performed by Local Unions that represent workers employed on the Project.

G. Any Local Union involved in a jurisdictional dispute on this Project shall continue working in accordance with Section 2 above and without disruption of any kind.

SECTION 4. AWARD

Any award rendered pursuant to this Article and the Plan shall be final and binding on the disputing Local Unions and the involved Contractor on this Project only and may be enforced in accordance with the provisions of Article VII of the Plan. Any award rendered pursuant to the alternate procedures of this Article shall be final and binding on the disputing Local Unions and the involved Contractor on this Project only, and may be enforced in any court of competent

jurisdiction. Such award or resolution shall not establish a precedent on any other construction work not covered by this Agreement. In all disputes under this Article, the General Contractor and the involved Contractors shall be considered parties in interest.

SECTION 5. LIMITATIONS

The Arbitrator shall have no authority to assign work to a double crew, that is, to more employees than the minimum required by the Contractor to perform the work involved; nor to assign work to employees who are not qualified to perform the work involved; nor to assign work being performed by non-union employees to union employees. This does not prohibit the establishment, with the agreement of the involved Contractor, of composite crews where more than 1 employee is needed for the job. The aforesaid determinations shall decide only to whom the disputed work belongs.

SECTION 6. NO INTERFERENCE WITH WORK

A. There shall be no interference or interruption of any kind with the work of the Project while any jurisdictional dispute is being resolved. The work shall proceed as assigned by the Contractor until finally resolved under the applicable procedure of this Article. The award shall be confirmed in writing to the involved parties. There shall be no strike, work stoppage or interruption in protest of any such award. Any Claims of a violation of this section shall be submitted and processed in accordance with the impediment to job progress provisions of the Plan.

B. In the event a Union alleged to have engaged in an impediment to job progress is an affiliate of a National or International Union that is not affiliated with the Building and Construction Trades Department and does not wish to have the impediment to job progress charge processed through the Plan, the parties to the dispute shall mutually select one of the three Arbitrators designated in this Article to hear the dispute. The selected Arbitrator shall schedule the hearing within two (2) business days from the date of submission. If he cannot hear the case within the required timeframe, one of the other Arbitrators shall be selected by the parties to hear the case unless all parties to the dispute agree to waive the two (2) day time limit. The sole issue at the hearing shall be whether or not a violation of this Section has in fact occurred, and the Arbitrator shall have no authority to consider any matter in justification, explanation or mitigation of such violation or to award damages. The Arbitrator's decision shall be issued in writing within three (3) hours after the close of the hearing, and may be issued without an opinion. If any party desires an opinion, one shall be issued within fifteen (15) days, but its issuance shall not delay compliance with, or enforcement of, the decision. The Arbitrator may order cessation of the violation of this Section and other appropriate relief, and such decision shall be served on all parties by facsimile upon issuance. Each party to the arbitration shall bear its own expense for the arbitration and agrees that the fees and expenses of the Arbitrator shall be borne by the losing party or parties as determined by the Arbitrator.

ARTICLE 11 – WAGES AND BENEFITS

SECTION 1. CLASSIFICATION AND BASE HOURLY RATE

All employees covered by this Agreement shall be classified in accordance with the work performed and paid the base hourly wage rates for those classifications as specified in the attached applicable Schedule A, as amended during this Agreement. Recognizing, however, that special conditions may exist or occur on the Project, the parties, by mutual agreement may establish rates and/or hours for one or more classifications, which may differ from the applicable Schedule A. Parties to such agreements shall be the Contractors involved, the involved Local Unions and the BTC.

SECTION 2. EMPLOYEE BENEFIT FUNDS

A. The Contractors agree to pay contributions on behalf of all employees covered by this Agreement to the established employee benefit funds in the amounts designated in the appropriate Schedule A; provided, however, that the Contractor and the Union agree that only such bona fide employee benefits as are explicitly required under N.J.S.A. 34:11-56.30 of the New Jersey State Labor Law shall be included in this requirement and paid by the Contractor on this Project. Bona fide jointly trusted fringe benefit plans established or negotiated through collective bargaining during the life of this Agreement may be added if similarly protected under N.J.S.A. 34:11-56.30. Contractors shall not be required to contribute to non-N.J.S.A. 34:11-56.30 benefits, trusts or plans.

B. The Contractor agrees to be bound by the written terms of the legally established Trust Agreements specifying the detailed basis on which payments are to be paid into, and benefits paid out of, such Trust Funds but only with regard to work done on this Project and only for those employees to whom this Agreement requires such benefit Payments.

C. Prior to the Project Engineer or any Contractor making any payment to a Contractor or sub-contractor, the Project Engineer or Contractor shall verify that the Contractor or sub-contractor has made contributions in full to the respective employee benefit funds. The Project Engineer or Contractor will obtain this verification in writing from the Contractor or sub-contractor prior to making any payment to a Contractor or sub-contractor.

D. Should any Contactor or sub-contractor become delinquent in the payment of contributions to the fringe benefit funds, then the sub-contractor at the next higher tier, upon notice of the delinquency claim from the Union or the Funds, agrees to withhold from the sub-contractor such disputed amount from the next advance, or installment payment for work performed until the dispute has been resolved.

ARTICLE 12 – HOURS OF WORK, PREMIUM PAYMENTS, SHIFTS AND HOLIDAYS

SECTION 1. WORK WEEK AND WORK DAY

A. The standard work week shall consist of forty (40) hours of work at straight time rates per one of the following schedules:

1. Five Day Work Week: Monday-Friday, 5 days, 8 hours plus ½ hour unpaid lunch period each day.

2. Four Day Work Week: Monday-Thursday, 4 Days, 10 hours plus ½ hour unpaid lunch period each day.

B. The Day Shift shall commence between the hours of 6:00 am and 9:00 am and shall end between the hours of 2:30 PM and 7:30 PM. Starting and quitting times shall occur at the employees' place of work as may be designated by the Contractor.

C. Scheduling: The Contactor shall have the option of scheduling either a five-day work week, or a four-day work week (when mutually agreed upon on a craft-by-craft basis). The Contractor shall also have the option to set the work day hours consistent with Project requirements, the Project schedule, and minimization of interference with site operations traffic flow. When conditions beyond the control of the Contractor, such as severe weather, power failure, fire or natural disaster, prevent the performance of Project work on a regularly scheduled work day, the Contractor may, with mutual agreement of the Local Union on a craft-by-craft basis, schedule Friday (where on 4 day 10 hours) during the calendar week in which a workday was lost, at straight time pay; providing the employees involved work a total of 40 hours or less during that work week.

D. Notice: Contractors shall provide not less than five (5) days prior notice to the Local Union involved as to the work week and work hours schedules to be worked or such lesser notice as may be mutually agreed upon.

SECTION 2. OVERTIME

Overtime pay for hours outside of the standard work week and work day, described in Article 12 Section 1 above, shall be paid in accordance with the applicable Schedule A. There will be no restriction upon the Contractor's scheduling of overtime or the non-discriminatory designation of employees who shall be worked, except as noted in Article 5, Section 2. There shall be no pyramiding of overtime pay under any circumstances. The Contractor shall have the right to schedule work so as to minimize overtime.

SECTION 3. SHIFTS

A. Flexible Schedules: Scheduling of shift work shall remain flexible in order to meet Project schedules and existing Project conditions including the minimization of interference with Owner operations. It is not necessary to work a day shift in order to schedule a second shift. Shifts must be worked a minimum of five consecutive work days, must have prior approval of the Owner and must be scheduled with no less than five (5) work days notice to the Local Union.

B. Second Shift: The second shift (starting between 2 PM and 8 PM) shall consist of 8 hours work (or 10 hours of work) for an equal number of hours pay at the straight time rate plus 15% in lieu of overtime and exclusive of a ½ hour unpaid lunch period.

C. Flexible Starting Times: Shift starting times will be adjusted by the Contractor as necessary to fulfill Project requirements subject to the notice requirements of Paragraph A.

D. Four Tens: When working a four-day work week, the standard work day shall consist of ten (10) hours work for ten (10) hours of pay at the straight time rate exclusive of an unpaid 1/2 hour meal period and regardless of the starting time. This provision is applicable to night shifts only, and such night shifts are subject to the shift differential in paragraph B above.

E. It is agreed that when project circumstances require a deviation from the above shifts, the involved Unions and Contractors shall adjust the starting times of the above shifts or establish shifts which meet the project requirements. It is agreed that neither party will unreasonably withhold their agreement.

SECTION E. HOLIDAYS

A. Schedule: There shall be eight (8) recognized holidays on the Project:

New Year's Day	Labor Day
Presidents Day	Veterans Day
Memorial Day	Thanksgiving Day
Fourth of July	Christmas Day

Work shall be scheduled on Good Friday pursuant to the craft's Schedule A.

All of the above holidays shall be observed on the dates designated by New Jersey State Law. In the absence of such designations, they shall be observed on the calendar date except those holidays which occur on Sunday shall be observed on the following Monday. Holidays falling on Saturday are to be observed on the preceding Friday.

B. Payment: Regular holiday pay, if any, and/or premium pay for work performed on such a recognized holiday shall be in accordance with the applicable Schedule A.

C. Exclusivity: No holidays other than those listed in Section 4.A above, shall be recognized nor observed except in Presidential Election years when Election Day is a recognized holiday.

SECTION 5. REPORTING PAY

A. Employees who report to work location pursuant to regular schedule and who are not provided with work or whose work is terminated early by a Contractor, for whatever reason, shall receive minimum reporting pay in accordance with the applicable Schedule A.

B. When an employee, who has completed his/her scheduled shift and left the Project site, is "called back" to perform special work of a casual, incidental or irregular nature, the employee shall receive pay for actual hours worked with a minimum guarantee, as may be required by the applicable Schedule A.

C. When an employee leaves the job or work location of his/her own volition or is discharged for cause or is not working as result of the Contractor's invocation of Section 7 below, they shall be paid only for the actual time worked.

D. Except as specifically set forth in this Article there shall be no premiums, bonuses, hazardous duty, high time or other special payments of any kind.

E. There shall be no pay for time not actually worked except as specifically set forth in this Agreement and except where an applicable Schedule A requires a full weeks pay for forepersons.

SECTION 6. PAYMENT OF WAGES

A. Payday: Payment shall be made by check, drawn on a New Jersey bank with branches located within commuting distance of the job site. Paychecks shall be issued by the Contractor at the job site by 10 AM on Thursdays. In the event that the following Friday is a bank holiday, paychecks shall be issued on Wednesday of that week. Not more than three (3) days wages shall be held back in any pay period. Paycheck stubs shall contain the name and business address of the Contractor, together with an itemization of deductions from gross wages.

B. Termination: Employees who are laid-off or discharged for cause shall be paid in full for that which is due them at the time of termination. The Contractors shall also provide the employee with a written statement setting forth the date of lay off or discharge.

SECTION 7. EMERGENCY WORK SUSPENSION

A Contractor may, if considered necessary for the protection of life and/or safety of employees or others, suspend all or a portion of Project Work. In such instances, employees will be paid for actual time worked; provided, however, that when a Contractor requests that employees remain at the job site available for work, employees will be paid for "stand-by" time at their hourly rate of pay. The same rules will apply in the case that the Project Engineer determines that a part or all of the Project work must be suspended if considered necessary for the protection of life and/or safety of employees or others.

SECTION 8. INJURY/DISABILITY

An employee who, after commencing work, suffers a work-related injury or disability while performing work duties, shall receive no less than 8 hours wages for that day. Further, the employee shall be rehired at such time as the employee is able to return to duties provided there is still work available on the Project for which the employee is qualified and able to perform.

SECTION 9. TIME KEEPING

A Contractor may utilize brassing or other systems to check employees in and out. Each employee must check in and out. The Contractor will provide adequate facilities for checking in and out in an expeditious manner.

SECTION 10. MEAL PERIOD

A Contractor shall schedule an unpaid period of not more than ½ hour duration at the work location between the 3rd and 5th hour of the scheduled shift. A Contractor may, for efficiency of operation, establish a schedule which coordinates the meal periods of two or more crafts. If an employee is required to work through the meal period, the employee shall be compensated in a manner established in the applicable Schedule A.

SECTION 11. BREAK PERIODS

There will be no rest periods, organized coffee breaks or other non-working time established during working hours. Individual coffee containers will be permitted at the employee's work location. Local area practice will prevail for coffee breaks that are not organized.

ARTICLE 13 – APPRENTICES

SECTION 1. RATIOS

Recognizing the need to maintain continuing supportive programs designed to develop adequate numbers of competent workers in the construction industry and to provide craft entry opportunities for minorities, women and economically disadvantaged non-minority males, Contractors will employ apprentices in their respective crafts to perform such work as is within

their capabilities and which is customarily performed by the craft in which they are indentured. Contractors may utilize apprentices and such other appropriate classifications as are contained in the applicable Schedule A in a ratio not to exceed 25% (twenty-five percent) of work force by craft (without regard to whether a lesser ratio is set forth in Schedule A), unless the applicable Schedule A provides for a higher percentage. Apprentices and such other classifications as are appropriate shall be employed in a manner consistent with the provisions of the appropriate Schedule A.

SECTION 2. DEPARTMENT OF LABOR

To assist the Contractors in attaining a maximum effort on this Project, the Unions agree to work in close cooperation with, and accept monitoring by, the New Jersey State and Federal Departments of Labor to ensure that minorities, women, or economically disadvantaged individuals are afforded opportunities to participate in apprenticeship programs which result in the placement of apprentices on this Project. To further ensure that this Contractor effort is attained, up to 50% (fifty percent) of the apprentices placed on this Project should be first year, minority, women or economically disadvantaged apprentices. The Local Unions will cooperate with the Contractor's request for minority, women or economically disadvantaged referrals to meet this Contractor effort.

ARTICLE 14 – SAFETY PROTECTION OF PERSON AND PROPERTY

SECTION 1. SAFETY REQUIREMENTS

Each Contractor will ensure that applicable OSHA requirements and other safety requirements set forth in the contract documents are at all times maintained on the Project and the employees and Unions agree to cooperate fully with these efforts. Employees must perform their work at all times in a safe manner and protect themselves and the property of the Contractor and the Owner from injury or harm. Failure to do so will be grounds for discipline, including discharge

SECTION 2. CONTRACTOR RULES

Employees covered by this Agreement shall at all times be bound by the reasonable safety, security, and visitor rules as established by the Contractors and the PENG for this Project. Such rules will be published and posted in conspicuous places throughout the Project.

SECTION 3. INSPECTIONS

The Contractors, Owner, Architect and Project Engineer retain the right to inspect incoming equipment of equipment, apparatus, machinery and construction materials of every kind.

ARTICLE 15 – NO DISCRIMINATION

SECTION 1. COOPERATIVE EFFORTS

The Contractors and Unions agree that they will not discriminate against any employee or applicant for employment because of race, color, religion, sex, national origin or age in any manner prohibited by law or regulation. It is recognized that special procedures may be established by the Contractors and Local Unions and the New Jersey State Department of Labor for the training and employment of persons who have not previously qualified to be employed on construction projects of the type covered by this Agreement. The parties to this Agreement will assist in such programs and agree to use their best efforts to ensure that the goals for female and minority employment are met on this Project.

SECTION 2. LANGUAGE OF AGREEMENT

The use of the masculine or feminine gender in this Agreement shall be construed as including both genders, unless otherwise specified.

ARTICLE 16 – GENERAL TERMS

SECTION 1. PROJECT RULES

The Owner, the Project Engineer and the Contractors shall establish such reasonable Project rules as are appropriate for the good order of the Project, provided they do not violate the terms of this Agreement. These rules will be explained at the pre-job conference and posted at the Project site and may be amended thereafter as necessary. Failure of an employee to observe these rules and regulations shall be grounds for discipline, including discharge. The fact that no order was posted prohibiting a certain type of misconduct shall not be a defense to an employee disciplined or discharged for such misconduct when the action taken is for cause.

SECTION 2. TOOLS OF THE TRADES

The welding/cutting torch and chain fall are tools of the particular trade having jurisdiction over the work performed. Employees using these tools shall perform any of the work of the trade. There shall be no restrictions on the emergency use of any tools or equipment by any qualified employee or on the use of any tools or equipment for the performance of work within the employee's jurisdiction.

SECTION 3. SUPERVISION

Employees shall work under the supervision of the craft foreperson or general foreperson.

SECTION 4. TRAVEL ALLOWANCES

There shall be no payments for travel expenses, travel time, subsistence allowance or other such reimbursements or special pay except as expressly set forth in this Agreement and in Schedule A limited to travel expenses.

SECTION 5. FULL WORK DAY

Employees shall be at their staging area at the starting time established by the Contractor and shall be returned to their staging area by quitting time after performing their assigned functions under the supervision of the Contractor. The signatories reaffirm their policy of a fair day's work for a fair day's wage.

SECTION 6. COOPERATION

The Owner, Contractors and the Unions will cooperate in seeking any New Jersey Department of Labor approvals that may be required for implementation of any terms of this Agreement.

ARTICLE 17 – SAVINGS AND SEPARABILITY

SECTION 1. THIS AGREEMENT

In the event that the application of any provision of this Agreement is enjoined, on either an interlocutory or permanent basis, or otherwise found in violation of law, the provision involved shall be rendered, temporarily or permanently, null and void but the remainder of the Agreement shall remain in full force and effect. In such event, the Agreement shall remain in effect for contracts already bid and/or awarded or in construction where the Contractor voluntarily accepts the Agreement. The parties to this Agreement will enter into negotiations for a substitute provision in conformity with the law and the intent of the parties for contracts to be let in the future.

SECTION 2. THE BID SPECIFICATIONS

In the event that the Contractors' bid specifications, or other action, requiring that a successful bidder become signatory to this Agreement is enjoined, on either an interlocutory or permanent basis, or otherwise found in violation of law such requirement shall be rendered, temporarily or permanently, null and void but the Agreement shall remain in full force and effect to the extent allowed by law. In such event, the Agreement shall remain in effect for contracts already bid and/or awarded or in construction where the Contractor voluntarily accepts the Agreement. The parties will enter into negotiations as to modifications to the Agreement to reflect the court action taken and the intent of the parties for contracts to be let in the future.

SECTION 3. NON-LIABILITY

In the event of an occurrence referenced in Section 1 or Section 2 of this Article, neither the Owner, the Architect, the Project Engineer, nor any Contractor, nor any signatory Union shall be liable, directly or indirectly, for any action taken, or not taken, to comply with any court order, injunction or determination. Project bid specifications will be issued in conformance with court orders in effect and no retroactive payments or other action will be required if the original court determination is ultimately reversed.

SECTION 4. NON-WAIVER

Nothing in this Article shall be construed as waiving the prohibitions of Article 7 as to signatory Contractors and signatory Unions.

ARTICLE 18 - HELMETS TO HARDHATS

SECTION 1. UTILIZE THE CENTER FOR MILITARY RECRUITMENT

The Employers and the Unions recognize a desire to facilitate the entry into the building and construction trades of veterans who are interested in careers in the building and construction industry. The Employers and Unions agree to utilize the services of the Center for Military Recruitment, Assessment and Veterans Employment ("Center") and the Center's "Helmets to Hardhats" program to serve as a resource for preliminary orientation, assessment of construction aptitude, referral to apprenticeship programs or hiring halls, counseling and mentoring, support network, employment opportunities and other needs as identified by the parties.

SECTION 2. CREATION OF AN INTEGRATED DATABASE OF INTERESTED VETERANS

The Unions and Employers agree to coordinate with the Center to create and maintain an integrated database of veterans interested in working on this Project and of apprenticeship and employment opportunities for this Project. To the extent permitted by law, the Unions will give credit to such veterans for bona fide, provable past experience.

ARTICLE 19 – FUTURE CHANGES IN SCHEDULE A AREA CONTRACTS

SECTION 1. CHANGES TO AREA CONTRACTS

A. The collective bargaining agreements attached as Schedule A to this Agreement shall continue in full force and effect until the Contractor and/or Union parties to the Area Collective Bargaining Agreements which are set forth in Schedule A notify the Contractors in writing of the mutually agreed upon changes in provisions of such agreements which are applicable to the Project, and their effective dates.

B. It is agreed that any provisions negotiated into any Schedule A collective bargaining agreements will not apply to work on this Project if such provisions are less favorable

to this Project than those uniformly required of contractors for construction work normally covered by those agreements; nor shall any provisions be recognized or applied on this Project it may be construed to apply exclusively, or predominantly, to work covered by this Project Labor Agreement.

C. Any disagreement between signatories to this Agreement over the incorporation into Schedule A collective bargaining agreement of provisions agreed upon in the renegotiations of Area Collective Bargaining Agreements shall be resolved in accordance with the procedure set forth in Article 9 of this Agreement.

SECTION 2. LABOR DISPUTES DURING AREA CONTRACT NEGOTIATIONS

The Unions agree that there will be no strikes, work stoppages, sympathy actions, picketing, slowdowns or other disruptive activity or other violations of Article 7 affecting the Project by any Local Union involved in the renegotiations of Area Local Collective Bargaining Agreements nor shall there be any lock-out on the Project affecting a Local Union during the course of such renegotiations.

ARTICLE 20 – DURATION OF AGREEMENT AND SIGNATURES

This Agreement shall be effective as of the ___ day of _____, 2026, and shall remain in full force and effect during the entire period of the construction of the Project described in Article 3, Section 1 hereof. As areas and systems of the Project are inspected and construction tested by the Project Engineer or Contractors and accepted by the Owner, the Agreement will not have any further force or effect on such areas, except when the Project Engineer or Contractors are directed by the Owner to engage in repairs, modifications, check-out and warranty functions required by its contract with the Owner during the term of this Agreement. Upon completion of the Project, this Agreement shall automatically terminate.

IN WITNESS WHEREOF the parties have caused this Agreement to be executed and effective as of the _____ day of _____, 2026.

SIGNATORIES:

For the City of Margate

_____
Authorized Signature

_____
Print Name

For the Project Engineer

_____ _____

Authorized Signature

_____ _____

Print Name

SOUTH JERSEY BUILDING AND CONSTRUCTION TRADES COUNCIL

_____ _____

Authorized Signature

_____ _____

Print Name

INDIVIDUAL UNIONS

_____

Asbestos Workers Local 89

_____

BAC Local 5

_____

Carpenters Local 255

_____

Cement Mason Local 592

_____

Elevator Constructors Local 5

_____

Glaziers Local 252

_____

IBEW Local 351

_____

Ironworkers Local 399

_____

Laborers Local 172

_____
Laborers Local 77

_____
Operating Engineers Local 825

_____
Painters District Council 711

_____
Plumbers & Fitters Local 322

_____
Roofers & Waterproofers Local 30

_____
Sheet Metal Workers Local 19 (Sign)

_____
Sheet Metal Workers Local 27

_____
Sprinkler Fitters Local 669

_____
Tapers Local 1976

_____
Teamsters Local 331

_____
Tile, Marble & Terrazzo- BAC Local 7

SCHEDULE A

LOCAL COLLECTIVE BARGAINING AGREEMENTS

(ATTACH HERE)

SCHEDULE B

LETTERS OF ASSENT

(ATTACH EXECUTED FORM HERE)

(When Executed Attached to Schedule B)

LETTER OF ASSENT

PROJECT LABOR AGREEMENT

The undersigned, as a Prime contractor or subcontractor on a Contract which is part of the construction project known as the New Margate Public Works Building for and in consideration of the award of a Contract to perform work on said Project, and in further consideration of the mutual promises made in the Project Labor Agreement, a copy of which was received and is acknowledged, hereby:

(1) On behalf of itself and all its employees, accepts and agrees to be bound by terms and conditions of the Project Labor Agreement, together with any and all amendments and supplements now existing or which are later made thereto, and understands that any act of noncompliance with all such terms and conditions, including but not limited to, evidence of compliance with the pre-employment controlled substance testing, will subject the noncomplying Contractor or employee(s) to being prohibited from the Project Site until full compliance is obtained.

(2) Certified that it has no commitments or agreements, which would preclude its full compliance with the terms and conditions of said Project Labor Agreement.

(3) Agrees to secure from any Contractor(s) (as defined in said Project Labor Agreement) which is or becomes a Subcontractor(s) (of any tier), a duly executed Letter of Assent in form identical to this document prior to commencement of any work.

_____ _____

Date Name of Contractor/Company

_____

Signature of Authorized Representative

_____

Print Name and Title

_____

Contract Number

SCHEDULE C

Scope of Project Construction Work

In general, this project consists of the construction of a New Public Works Building to be located on Block 324.01, Lot 125 in Margate City, Atlantic County, New Jersey. The proposed facility includes a building with a ground floor of 6,731 square feet and a second floor of 5,947 square feet associated site improvements and improvements in the Monmouth Avenue right-of-way. The existing public works facility on the site will remain in operation during construction located on Lot 2.01 will be demolished by others under a separate contract prior to the start of construction. This project includes all architectural, structural, civil/site, mechanical, electrical, plumbing, and fire protection systems complete in order to provide a turnkey facility for immediate use and occupation by the Margate City Public Works Department.

APPENDIX E

CAPE ATLANTIC
CONSERVATION DISTRICT

6260 Old Harding Highway
Mays Landing, New Jersey 08330
Phone (609) 625-3144 Fax (609) 625-7360
www.capeatlantic.org

May 14, 2025

Johanna Casey (via email)
City of Margate
9001 Winchester Avenue
Margate, NJ 08402

RE: CERTIFICATION – SOIL EROSION AND SEDIMENT CONTROL PLAN
APPLICATION NO. 212-25 PROJECT NAME: Public Works Building
BLOCK(S): 324.01 LOT(S): 125 ADDRESS: Benson & Winchester Avenues
MUNICIPALITY: Margate
PLANS PREPARED BY: Remington & Vernick Engineers
DATE: 4/14/2025 LAST REVISED DATE: ---

Pursuant to the New Jersey Soil Erosion and Sediment Control Act; N.J.S.A. 4:24-39 et seq. the Cape Atlantic Conservation District has reviewed the erosion control application and hereby grants certification of the soil erosion and sediment control plan for the above referenced project subject to the following:

1. That the applicant carries out all land disturbance activities in accordance with the Standards for Soil Erosion and Sediment Control in New Jersey, promulgated by the State Soil Conservation Committee. A copy of the Erosion Control Plan must be on site.
2. The owner/applicant must obtain a District issued Report of Compliance prior to the issuance of any Certificates of Occupancy by the municipality. **Requests for Certificates of Compliance must be made Five (5) working days in advance.**
3. Revisions to the certified plan relating to, or that will affect land disturbance on the site, must be submitted to the District office for certification.
4. Any conveyance of the project (or portion thereof) prior to its completion will transfer full responsibility for compliance to subsequent owner(s). The District must be notified in writing of any change of ownership.
5. This approval is limited to the soil erosion and sedimentation controls specified in this plan. It is not authorization to engage in the proposed land use unless such use has been previously approved by the municipality or other controlling agency.
6. This Certification is valid for three & one-half years (3½) and will **expire on 11/11/2028.**

The District requires written notification at least 48 hours in advance of any land disturbance activity **(use enclosed Start of Land Disturbance Notice).**

Failure to comply with the above conditions may result in the issuance of a **STOP CONSTRUCTION ORDER.**

If there are any questions, please feel free to call our office.

Robert H. Fenton,
Chairman

cc: Dino Cavalieri, Construction Official
Michael Iaconelli, RVE (via email)

NOTICE OF START OF LAND DISTURBANCE

Job Supervisor:_____ Phone#:_____

Co. Name:_____ Fax#:_____

Address:_____ Cell#:_____

City, State, Zip:_____

Project Name:_____

Municipality:_____

District Application#:_____

Last Revised Date of Plans:_____

This will serve as the required 48 hour notice as to the start of the above mentioned project. This project will start on:_____

Failure to notify this office of start of construction will result in the issuance of a violation notice and/or a stop work order.

Please mail your completed form to:

Cape Atlantic Conservation District
6260 Old Harding Highway
Mays Landing, NJ 08330

Or

Email: MarieRogowski@capeatlantic.org

CAPE ATLANTIC
CONSERVATION DISTRICT

6260 Old Harding Highway
Mays Landing, New Jersey 08330
Telephone: (609) 625-3144
Fax: (609) 625-7360
www.capeatlantic.org

Request for Inspection to Obtain Report of Compliance

Email All Inspection Requests to: Inspections@capeatlantic.org

District Application Number: _____

Municipality: _____

Name of Project: _____

List properties to be inspected:

Block	Lot	Street Address
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Will inspection be for: Conditional Compliance _____ or *Complete Compliance _____

Your Name: _____

Your Company: _____

Phone Number: _____

Fax Number: _____

Cell Phone Number: _____

Do you want Report **(choose one)** Left on site _____ Faxed _____ Emailed _____ Mailed _____.

Fax Number: _____ Email Address: _____

Mailing Address: _____

_____

Date when site will be ready for District to inspect: _____

(NOTE: INSPECTION REQUEST MUST BE MADE 5 WORKING DAYS IN ADVANCE)

Property must be final graded, and a permanent driveway cover must be complete. Temporary or permanent erosion control measures must be implemented, in accordance with the approved Soil Erosion and Sediment Control Plans.

All streets and units must be properly identified. A Report of Compliance will not be released for a unit if it can not be identified. **Identify all units at the site by Block, Lot, and Street Address.**

** Binding Letter of Intent Form may be utilized to obtain a Report of Complete Compliance for detached single family units.* ***(see website for form)***