

TOWN OF SHARON

MASSACHUSETTS



M.G.L. Chapter 149 Bid
INFORMATION FOR BIDDERS

FORMS FOR BID
AGREEMENT AND BONDS
AND SPECIFICATIONS

FOR

SHARON WATER DEPARTMENT WATER BUILDING RENOVATION

December 20, 2023

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**TOWN OF SHARON
DEPARTMENT OF PUBLIC WORKS
NOTICE TO BIDDERS**

Sealed Bids under M.G.L. c. 149 for the **Department of Public Works – Sharon Water Department Water Building Renovation Project** bids will be received by the Department of Public Works, 217 Rear South Main Street, Sharon, Massachusetts 02067, on behalf of the Sharon Water Department. **Under M.G.L. c. 149, prevailing wage (see Appendix B) rate and equal employment opportunity hiring and bidding is required.**

DCAMM Certification is required for General and Filed Sub-bid Contractors.

Bid Forms and Contract Documents shall be available online on Wednesday December 20, 2023 after 9:00 AM. Neither Owner nor Architect/Engineer shall be responsible for full or partial sets of Bidding Documents, including Addenda if any, obtained from sources other than Tim Chouinard.

Pre-Bid Site Walk Through: A walk-through of the project is scheduled for January 3, 2024 at 2:00 p.m, at the project site, located next to the railroad overpass on the Providence side of the Sharon Train Station. The address of the building is 5 Upland Road. Contact Timothy Chouinard, Facilities Supervisor at (781) 784.1525, extension 2325.

Filed sub-bids will be received until January 18, 2024 at 2:00 PM in the categories of: Plumbing, HVAC and Electrical.

General Bids will be received until February 1, 2024 at 2:00 PM and publicly posted, forthwith online.

THIS PROJECT IS BEING ELECTRONICALLY BID AND OPENED. HARD COPY BIDS WILL ALSO BE REQUIRED FOR SUBMISSION.

All Bids should be submitted electronically online to: tchouinard@townofsharon.org and received no later than the date and time specified above. For assistance, contact Tim Chouinard at (781) 784-1525, ext. 2325.

Please review the instructions on the townofsharon.net website on how to access the virtual bid opening via Zoom. The electronic bid documents are available online at townofsharon.net under “Proposals/RFPs and IFBs” (see bottom of home page).

PART 1 - GENERAL

The office portion of the Town of Sharon Water Department Water Station will be receiving interior renovations with careful attention to maintaining historically accurate

details where possible as this is the oldest building in Sharon, MA. The Sharon Water Department building is located on the Providence side of the Sharon Train Station and its address is 5 Upland Road. Sharon Water Department Masonry Restoration Project bidders should bid on the project as outlined in the Specifications listed in “Appendix A. The winning bidder will have to carry a 100% payment and 100% performance bonds the project. All contractors must be insured as per the bid requirements. The Bid Guaranty may be in the form of a Bid Bond or Bank Cashier Check made payable to the Town of Sharon.

The Official Bid Document will only be available electronically.

The winning contractor must complete all work by September 1, 2024, or as agreed to with the Town of Sharon.

An award will not be made to a bidder who is not properly equipped to undertake and complete the work. Bids, which do not include a properly completed “Affidavit” pertaining to Non-Collusion, etc., will be declared informal. The Right to waive any informality and to reject any and all Bids is reserved.

Prevailing wage rates for this project have been established and are located in Appendix B of this bid document.

INSTRUCTION TO BIDDERS

All bids shall be submitted to The Town of Sharon and prepared in accordance with these instructions and other provisions of the contract Documents, and all bids will be available for viewing online at townofsharon.net under “Proposals/RFPs and IFBs” (see bottom of home page). In addition to online submissions, the Town of Sharon is requiring a hard copy submission to the Department of Public Works – Sharon Water Department located at the Department of Public Works, 217 Rear South Main Street, Sharon MA 02067, **by the deadline.**

The Town of Sharon is exempt from payment of the Massachusetts Sales Tax. Therefore, Bidders shall make no allowance for said Sales Tax in the prices bid. NOTE: this bid is a prevailing wage job. **All bids should be based on the prevailing wage numbers included in Appendix B at the back of this bid document. The winning bidder will be responsible for submitting weekly payroll sheets required as part of any prevailing wage project.**

All Bids submissions shall be made as follows:

1. The following documents must be submitted with the Filed Sub Bid:
 - a. Certificate of Non-Collusion
 - b. Acknowledgement of Principal (3 versions)
 - c. Affidavit of Compliance
 - d. Certificate of Authority
 - e. Statement of Wage Compliance
-

- f. DCAMM Certification
 - g. DCAMM Update Statement
 2. The following documents must be submitted with the General Contractor's Bid:
 - a. Bid Bond
 - b. Certificate of Non-Collusion
 - c. Acknowledgement of Principal (3 versions)
 - d. Affidavit of Compliance
 - e. Certificate of Authority
 - f. Statement of Wage Compliance
 - g. DCAMM Certification
 - h. DCAMM Update Statement
 - i. Statement of Independent Certified Public Accountant
 - j. Contractor's Certification as to Internal Account Controls
 3. Fill in the total lump sum bid price in the "Schedule of Prices" in the Bid. The winning bidder will be the General Contractor for the project and is responsible for bidding the entire project in a lump sum. Fill in all Add/Alt items. All bidders must submit Add/Alt pricing. Bidders that do not will be disqualified.
 4. Fill in the Number of Addenda, if any (See Page 7 and 8).
 5. Submit as the Bid all Contract Documents intact, without changing any of the text, enclosed in a sealed envelope bearing the name and address of the Bidder, and endorsed "**Bid for Sharon Water Department Water Building Renovation Project**".
 6. Submit to the Town of Sharon as bid deposit a **bid bond**, cash, certified check, treasurer's check or cashier's check in the amount **5%** of the total bid price.
 7. Fill in blank spaces and sign certificate of non-collusion.
 8. Submit references for last five years on page 15 and submit with bid. References must be for commercial renovation projects and provide proof of experience with such projects. **Applicants without proof of commercial renovation experience will not be considered competent for the purposes of this bid and their bids will be rejected.**
 9. **A 100% Payment bond** (for entire project cost) will be required to be obtained following acceptance of the "Notice of Award" by the winning Bidder (as per MGL Chapter 149).
 10. **A 100% Performance bond** will be required and retained from the low-bidder for one year. The bond will be used as surety to guarantee that installation issues that may arise are addressed by the contractors.
 11. Include change order hourly rate on the "Summary Sheet - Schedule of Prices" page.
-

Checks shall be made payable to "Town of Sharon". The bid deposit shall not be enclosed in the sealed envelope containing the Bid.

Checks will be returned to all except the three lowest formal Bidders within five days (Saturdays, Sundays and legal holidays excluded) after the opening of the Bids, and the remaining deposits will be returned to the three lowest Bidders within 48 hours after the awarding of Contract, or if no Contract is awarded within 30 days (not including Saturday, Sunday and legal holidays), after the date of opening bids, then upon demand of the Bidder, at any time thereafter so long as he has not been notified of the acceptance of his/her Bid. The successful Bidder will be notified by registered mail of the acceptance of his/her Bid.

If a bid bond is used as bid security, it shall be prepared in the Form of Bid Bond attached hereto each duly executed by the Bidder as Principal and having as Security thereon a surety company approved by the Owner. A copy of the Form of Bid Bond will be furnished to the Bidder by the Engineer upon request.

A Performance Bond and a Labor and Materials Payment Bond by a company satisfactory to the Owner will be required from the successful Bidder for the faithful performance of the Contract and as security for payment of all persons performing labor and furnishing materials in connection with this Contract. The bonds shall be in accordance with the forms attached to the Contract Documents.

No Bidder may withdraw his Bid for a period of thirty (30) days (not including Saturdays, Sundays and legal holidays), after the date set for the opening of the Bids.

In the case of each Bid, the Owner reserves the right to satisfy itself as to the complete responsibility of the Bidder, toward which objective every Bidder is required to furnish all information requested in the Bid.

Notice of the acceptance of his/her Bid will be given to the successful Bidder by the Owner by posting a registered letter to the Bidder's address stated in said Bid. If, within five (5) days, Saturdays, Sundays, and legal holidays excluded, immediately after the receipt of Notice of Award, the successful Bidder shall fail to deliver his bonds properly executed and his Contract duly signed, in consideration of such failure the Bid and acceptance, at the option of the Owner, may become null and void and the bid security accompanying his Bid shall become the property of the Owner, which may proceed to accept another Bid.

The contractor shall start work under this Contract and shall continue it to completion with all practical dispatch and regularity; the work shall be started and completed within the times required by the Contract.

The contractor shall deliver to the Town as built drawings, operation/maintenance manuals, warranties and the like, prior to completion of the project, as applicable.

The sum of **One hundred Dollars (\$100.00) per day** is to be agreed upon as liquidated damages, and shall be paid by the Contractor to the Owner for each and every calendar

day in which any work of the Contract is incomplete after the times stipulated for such completion, and the prices bid shall be fixed with regard to this provision. Deductions for liquidated damages will be made from payments owed to the Contractor. In the event that unforeseen issues arise, the owner may provide an extension to the deadline but the decision will be made, in writing, at the sole discretion of the Owner.

Workmen's Compensation, Property Damage, Public Liability, Owner's Protective Liability, and fire and Builders' Risk Insurance requirements are set forth in detail in the Selectmen's Policy Number 11, General Conditions III.

Massachusetts Wage Rates as established pursuant to the provisions of M.G.L. c 149, ss. 26-27G apply to this project. The Massachusetts Wage Determination is attached to these Specifications. It is the responsibility of the Contractor, before bid opening, to require, if necessary, any additional information on Massachusetts Wage Rates for those trades people who are not covered by the applicable Massachusetts Wage Rates Decision, but who may be employed for the proposed work under this contract. Certified Payroll Sheets may be sent to Peter O'Cain – Town Engineer at 217 Rear South Main Street, Sharon, MA 02067.

The Contractor shall keep himself/herself informed fully of, and comply with, all Laws, Ordinances, and Regulations of the Federal, State or Municipal Governments, which may be in forced during the life of the Contract, in any manner affecting his employed in the work.

Any request from a prospective Bidder for the interpretation of meaning of the Specifications or other Contract Documents shall be made in writing to Alan Westman, KSID, LLC, 1749 Central Street, Suite 2, Stoughton, MA 02072 and to be given consideration must be received at least seven (7) days prior to Bid deadline, Interpretations will be made by the Superintendent of Public Works and or Town Engineer as requested, and all interpretations will be made in the form of written Addenda to the Contract Documents, which Addenda will become a part of the Contract. Not later than three (3) days prior to the date fixed for the opening of Bids, the Addenda will be faxed to all persons who Advertisement for Bids. Failure of any bidder to receive any such Addenda shall not relieve any Bidder from any obligation under his Bid as submitted.

At the date fixed for the opening of Bids, it will be presumed that each Bidder has made an examination of the locations and sites of the work to be done under the contract, has satisfied as to the actual conditions, requirements and quantities of work, and has read and become thoroughly familiar with the Contract documents, including the specifications, and all Addenda to them, if any. **All bidders must visit the site in order to bid on the project with accuracy.**

Contracts for work under this Bid will obligate the Contractors and Subcontractors not to discriminate in employment practices.

The failure or omission of any Bidder to receive or examine any form, instrument or document shall in no way relieve the bidder of any obligation in respect to his/her Bid.

The Owner reserves the right to waive any informality in the Bids, to reject any or all Bids if it be in the public interest so to do. The Contract will be awarded to the lowest responsible and eligible Bidder possessing the skill, ability and integrity necessary to the faithful performance of the work and who shall certify that he/she is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the project.

Massachusetts General Laws, Chapter 30, Sections 39F, 39G, 39N, 39O, 39P and 39R are quoted in the General and Supplementary Conditions.

Town of Sharon, Massachusetts

By The Select Board Members:

Kiana Pierre-Louis, Chair _____

Hanna Switekowski _____

Emily E. Smith-Lee _____

BID

To the Town of Sharon, Massachusetts, acting by its Board of Selectmen, hereinafter called the Owner:

A. The undersigned proposes to furnish all labor and materials required for the **(Department of Public Works – Sharon Water Department Water Building Renovation Project** in Sharon, Massachusetts, in accordance with the accompanying Specifications, the Instructions to Bidders, and other Contract Documents bound herewith prepared by KSID, LLC for the Estimated Total Contract Price specified in the Schedule of provided for in the contract.

The undersigned, declares: that the only persons interested in this Bid as principals are named herein as such; that no official of the Owner and no person acting for or employed by the Owner is interested directly or indirectly in this Bid, or in any contract which may be made under it, or in any expected profits to arise therefrom; that this Bid is made in good faith, without fraud, collusion or connection with any other person bidding or refraining from bidding for the same work; that he has examined carefully the said instructions and all other documents bound herewith, and the Drawing relating to the contract covered by this Bid and hereby makes them part of this Bid; that he/she has informed himself/herself fully in regard to all conditions pertaining to the work and the place where it is to be done; and that he/she has made his/her own examination and estimates of cost and from them makes this Bid.

The undersigned proposes and agrees that, if within thirty (30) days (Saturdays, Sundays and legal holidays excluded) after the date named in the Instructions to Bidders as that for submitting this Bid to the Owner, notice that this Bid has been accepted by the Owner shall be mailed to him/her at the business address given herein, he/she will, on some one of the five (5) days, (Saturdays Sundays and legal holidays excluded), immediately following receipt of such Notice of Acceptance of this Bid, appear at the office of the Town Engineer and deliver to the properly accredited representative of the Owner a contract, together with Performance Bond and Labor and Material Payment Bond furnished by a company satisfactory to the Owner, which contract and bonds shall be executed in the forms annexed hereto, and which contract shall provide that the Owner, as full compensation for doing and completing the work of carrying out the requirements of the Agreement, General Conditions, supplementary Conditions, Specifications and Drawings, shall pay the Contractor the unit prices and lump sums which he has recorded in the Bid, or such unit prices and lump sums increased or decreased in a manner as provided for in the contract.

The undersigned also agrees that the bid security which, as called for in the Instructions to Bidders, accompanies this Bid shall become the property of the Owner as compensation for damage suffered by said Owner should the undersigned fail to execute the said contract and bonds if notified, as specified above, that this Bid has been accepted. But if this Bid is not accepted by the Owner, as specified above, within (30) days of the date set for the submission of the Bid, (not including Saturdays Sundays and legal holidays), or if the Notice of Acceptance is received by the undersigned and he/she

complies with the requirements as to execution of the contract and bonds, then the bid security referred to will be returned to him/her.

The undersigned understands that it is the intention of the Owner not to award a contract for this work under this or any other Bid if the Bidder cannot furnish satisfactory evidence that he/she has the ability and experience to perform this class of work and that he/she has sufficient capital and equipment to enable him/her to prosecute the work successfully and to complete it within the time named in the contract, and that the Owner reserves the right to reject this or any other Bid or to award the contract as is deemed to be to the best interest of the Owner. The undersigned understands further that the quantities given in the Schedule of Prices in this Bid are approximate only and are given as a basis for the comparison of Bids, that the Owner does not agree, expressly or by implication, that the actual amount of work will correspond even approximately therewith but reserves the right to increase or decrease the amount of any item of the work listed as may be found desirable or necessary during the carrying out of the construction work; and that the unit prices quoted in the Schedule of Prices shall apply without change to such variation in the quantity of each or all items.

The undersigned further agrees that he/she will, upon request, furnish in confidence such information as will enable the Owner to judge the financial responsibility of himself/herself and his/her proposed Subcontractors.

That the Contractor shall give to the Owner, as liquidated damages, for each calendar day lost by the Contractor in the completion of the contract after the time herein stipulated, the sum of One Hundred dollars (\$100) per day.

INDEMNIFICATION

The Contractor shall defend, indemnify and hold harmless the Town from and against any and all claims, liability, loss, damages, costs or expenses for personal injury or damage to real or tangible personal property which the Town may sustain, incur or be required to pay, arising out of or in connection with services performed under this Contract or by reason of any negligent action/inaction or willful misconduct of the Contractor, its agent(s) or person(s) employed by the Contractor, any of its subcontractors or other entities for which the Contractor is legally responsible, to the fullest extent allowed by law.

B. This Bid includes Addenda numbered _____.

C. The Schedule of Prices referred to herein is as follows:
(SEE SUMMARY SHEET).

SUMMARY SHEET -SCHEDULE OF PRICES

Sharon Water Water Building Renovation Project.

SEE APPENDIX A FOR LIST OF ADD/ALT ITEMS

(Base bid price w/o Add/Alt items) (\$ _____)

(Add/Alt Item 1 – In lieu of acoustical ceiling tile, provide GWB ceiling in Rooms 103 and 104 as noted under ‘Add Alternate’ section on Sheet A200) (\$ _____)

CHANGE ORDERS: The contractor may not proceed with ANY work that adds cost above the amount bid without the written approval of the Owner. The bidder will provide the Owner with a written lump sum fixed estimate for the work to be performed. In the event that the Owner finds that the work is more than what is found to be fair (by obtaining quotes from other contractors) the Owner has the right and duty to hire an outside contractor to provide services. By accepting an award from the Owner for the Sharon Water Building Renovation Project, the winning bidder accepts all the conditions of the bid document.

This Bid Acknowledges addenda:

Addenda # _____ Signature: _____

Addenda # _____ Signature: _____

Addenda # _____ Signature: _____

Addenda # _____ Signature: _____

Addenda # _____ Signature: _____

Addenda # _____ Signature: _____

The undersigned hereby certifies that he/she is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the work.

The undersigned offers the following information as evidence of his qualifications to perform the work as bid upon according to all the requirements of the Drawings and Specifications:

The names and addresses of all persons and parties interested in this Bid as principals are as follows:

Note: give the first and last names in full. In case of a corporation, give names of officers and directors; in case of a partnership, give names of all partners.

The undersigned also agrees that all work to be performed by subcontractors is as follows:

Description of Subcontract work	Name and Address of Subcontractor
---------------------------------	-----------------------------------

The undersigned submits answers to the following questions to enable the Owner to judge of his/her experience and ability in, and facilities for the work proposed to be done.

1. The work, if awarded to you, will have the resident personal supervision of whom?
State his or her special qualifications.

2. Describe equipment you propose to furnish.
(A) Your own (B) Rented:

(A) _____

(B) _____

3. How many years has your organization been in business as a General contractor under the name in which you propose?

4. List all projects that your present organization completed of character similar to that proposed for the past 5 years (2017-2023). Give the information indicated by the following tabulation:

Name and Address of Owner	Work Done as Contractor /Subcontractor	Description of work	Approx. Amt. Of Contract	Approx. Date Was Done

5. Has your present organization ever failed to complete any work awarded to it? If so, state when, where, and why.

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we the undersigned

_____, as Principal, and
(insert name of bidder)

_____, as Surety, are hereby held
(insert name of surety)

and firmly bound unto the Town of Sharon, MA, in the sum of \$_____ (per M.G.L. c149, 5% of value of total bid or sub-bid is required) as liquidated damages for payment of which, will and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors, and assigns.

The condition of this obligation is such that whereas the Principal has submitted to the Town of Sharon, MA a certain Bid attached hereto and hereby made a part hereof, to enter into a contract in writing, hereinafter referred to as the "AGREEMENT" and/or "CONTRACT,"

NOW THEREFORE

(a) If said BID shall be rejected or withdrawn as provided in the INFORMATION FOR BIDDERS attached hereto or, in the alternative,

(b) If said BID shall be accepted and the Principal shall duly execute and deliver the form of AGREEMENT attached hereto and shall furnish the specified bonds for the faithful performance of the AGREEMENT and/or Contract and for the payment for labor and materials furnished for the performance of the AGREEMENT and/or contract,

then this obligation shall be void, otherwise it shall remain in full force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims there under in no event shall exceed the amount of this obligation.

The Surety, for value received, hereby agrees that the obligations of said Surety and its bond shall be in no way impaired or affected by any extensions of the time within which such BID may be accepted, and said Surety does hereby waive notice of any such extensions.

IN WITNESS WHERE OF, the parties hereto have duly executed this bond on the
_____ day of _____, 20_____.

(SEAL)

BY: _____ L. S.

(Name of Surety)

BY: _____

Sealed and delivered in the presence of:

CERTIFICATE OF NON-COLLUSION

The undersigned certifies under penalties of perjury that this bid is in all respects bonafide, fair and made without collusion or fraud with any other person. As used in this section the word 'person' shall mean any natural person, joint venture, partnership, corporation, or other business or legal entity.

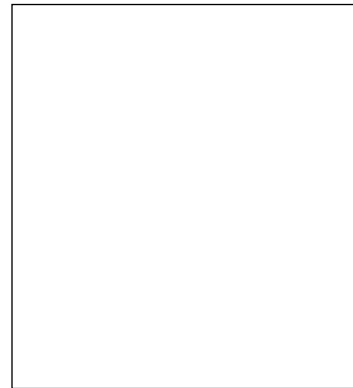
Authorized Signature

Date

Social Security Number or Federal
Identification Number

Legal Name or Business Entity (Please Print or Type)

Address:



Corporate Seal Here (if applicable)

TOWN OF SHARON, MASSACHUSETTS

Sharon Water Department Water Building Renovation Project

NOTICE OF AWARD

TO:

The OWNER has considered the BID submitted by you for the above-described WORK in response to its Advertisement for Bids dated _____ and Information for Bidders.

You are hereby notified that your BID has been accepted for items in the amount of _____

You are required by the Information for Bidders to execute the Agreement and furnish the required CONTRACTOR'S PERFORMANCE BOND, PAYMENT BOND, and CERTIFICATES OF INSURANCE ten (10) calendar days from the date of this Notice to you.

If you fail to execute said Agreement and to furnish said BONDS within ten (10) days from the date on this Notice, said OWNER will be entitled to consider all your rights arising out of the OWNER'S acceptance of your BID as abandoned and as a forfeiture of your BID SECURITY. The OWNER will be entitled to such other rights as may be granted by law.

You are required to return an acknowledged copy of this NOTICE OF AWARD to the OWNER.

Dated this _____ day of _____, 2024.

c/o Department of Public Works
Town of Sharon, Massachusetts
Owner

By _____
Title Chairman, Board of Selectmen

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE OF AWARD is hereby acknowledged

BY: _____
this the _____ day of _____, 20____
BY: _____ Title _____

AGREEMENT

Sharon Water Department Water Building Renovation Project

This Agreement, made and executed this _____ day of _____ in the year 2024 by and between the Town of Sharon, MA, a municipality located within the County of Norfolk in the Commonwealth of MA, by its Board of Selectmen, duly constituted, and without personal liability for the individuals signatory hereto, said Town of Sharon being herein termed the Owner, party of the first part, and

_____ hereinafter termed the Contractor, party of the second part: Witness that the parties to this Agreement each in consideration of the agreements on the part of the other herein contained have agreed, and by these presents do hereby agree, the Owner for itself, and the Contractor for himself and his heirs, executors, administrators, successors and assigns as follows:

That the Contract Documents consisting of this Agreement, together with the Information for Bidders, Instructions to Bidders, Bids, Bonds, General Conditions, Supplementary Conditions, and Specifications hereto attached, the Drawings referred to herein and in the Specifications, and any Addenda issued before execution of the Agreement, form the Contract:

That the Contractor has informed himself/herself fully in regard to all conditions pertaining to the place where the work is to be done and other circumstances affecting the work:

That the Contractor has obtained all the information he/she needs to enable him/her to estimate fully and fairly the costs of the work herein contemplated:

That the Contractor agrees to perform the work for a total of _____
The Contractor shall furnish all labor, materials, supplies, tools, equipment and other facilities and things necessary or proper for, or incidental to, the completion of the **Sharon Water Department Water Building Renovation Project**, for the party of the first part in accordance with this Contract. The Contractor shall complete everything required of him/her under this Contract no later than the time stated in the Contract: Prior to execution of a construction contract, the Contractor and filed sub-bidder(s) (where applicable) shall submit for review by the Owner, documentation to establish the markup percentage(s) for direct labor costs.

That the Owner shall pay and the Contractor shall receive as full compensation for invoices submitted to the Town after the work has been inspected and approved by the Assistant Town Engineer, Superintendent of Public Works or the Building Inspector of the Town of Sharon.

Project cost will not exceed the \$ _____ amount agreed to by the Contractor for all work delineated in the project bid package.

The sum of one hundred (\$100.00) dollars is to be agreed upon as liquidated damages, and shall be paid by the Contractor to the Owner for each and every calendar day in which any work of this contract is uncompleted after the times stipulated for such completion, and the prices bid shall be fixed with regard to this provision, reductions for liquidated damages will be made from payments due the Contractor.

All work shall be completed before September 1, 2024.

Signed, sealed, and delivered in quadruplicate the day and year first above written.

Town of Sharon, Massachusetts, Board of Selectmen

BY: (Selectboard) _____

Kiana Pierre-Louis, Chair _____

Hanna Switekowski _____

Emily E. Smith-Lee _____

BY: (Contractor) _____

Approved as to form

Town Counsel

Certification of Appropriation

By: _____

Town Accountant

IMPORTANT - Execute acknowledgment of officer or agent who signs this document.

ACKNOWLEDGMENT OF PRINCIPAL, IF A CORPORATION

State of _____

County of _____

On this _____ day of _____, 2024

before me personally came and appeared _____ to me known,
who, being duly sworn, did depose and say that he/she _____
resides at _____
that he/she is the _____
of _____ the corporation described in
and which executed the foregoing instrument; that he knows the seal of said corporation;
that one of the impressions affixed to said instrument is an impressions affixed to said
instrument is an impression of such seal; that it was so affixed by order of the Directors
of said corporation, and that he/she signed his/her name thereto by like order.

(SEAL)

(Notary Public)

My commission expires:

ACKNOWLEDGMENT OF PRINCIPAL, IF A PARTNERSHIP

State of _____

County of _____

On this _____ day of _____, 2024

before me personally came and appeared _____

to me known and known to me to be one of the members of the firm of

described in and who executed the foregoing instrument and he acknowledged to me that he executed the same as and for the act and deed of said firm.

(SEAL)

(NOTARY PUBLIC)

My Commission expires :

ACKNOWLEDGMENT OF PRINCIPAL, IF AN INDIVIDUAL

State Of _____

County of _____

On this _____ day of _____, 2024

before me personally came and appeared _____

to me know and know to me to be the person described in and who executed the foregoing instrument and acknowledged that he executed the same.

(SEAL)

(NOTARY PUBLIC)

My Commission expires:

PERFORMANCE BOND

Know all men by these presents, that _____
(hereinafter called the principal) as principal, and _____
a corporation organized and existing under the laws of the _____
with its principal office _____, (hereinafter called the
surety) as surety, are held and firmly bound unto _____
(Awarding Authority), (hereinafter called the obligee), in the just and full sum of
_____dollars and _____to the
payment of which sum, well and truly to be made, the said principal and surety bind
themselves, and their respective heirs, administrators, executors, successors and assigns,
jointly and severally, firmly by these presents. Whereas, the principal has entered into a
certain written contract _____of _____2024
for the _____in the Town of Sharon,
Sharon, Massachusetts, as outlined in the specifications, which contract is hereby referred
to and made a part hereof as fully and to the same extent as if copied a length herein.
Now therefore, the condition of this obligation is such that if the said principal shall well
and truly perform and fulfill all the undertaking, covenants, terms, conditions, and
agreements of said contract during the original term of said contract and any extensions
thereof that may be granted by the obligee with or without notice to the surety, and shall
also well and truly perform and fulfill all the undertakings, covenants, terms, conditions,
and agreements of any and all duly authorized modifications of said contract that may
hereinafter be made, notice of which modifications of said contract that may hereinafter
be made, notice of which modifications to the surety being to remain in full force and
virtue. Provided, however, it shall be a condition precedent to any right of recovery here
under that the obligee, upon discovery of any default on the part of the principal, shall
within a reasonable time deliver to the surety by registered mail at its office at _____
_____a written statement substantially
setting forth the nature of such default. And provided further that no action, suit, or
proceeding shall be had or maintained against the surety of this instrument unless the
same be brought or instituted and process served upon the surety within three years after
completion of the work mentioned in said contract, whether such work be completed by
the principal, surety or obligee, but if there is any maintenance period provided in the
contract for which said surety is liable, an action for maintenance may be brought within
three years from the expiration of the maintenance period, but not afterwards.

In witness whereof, the said principal and surety have signed and sealed this instrument
this _____day of _____2024

By: _____
(Principal)

By: _____
(Surety Company)

LABOR AND MATERIALS BOND

KNOW ALL MEN BY THESE PRESENTS: That we, _____

trading under the firm name of _____

of the city _____ county of _____

State of _____ as PRINCIPAL, and the

_____ a corporation organized and

existing under the laws of the State of _____, as

Surety, are held and firmly bound unto the Town of Sharon, Sharon, Massachusetts, in

the sum of _____ lawful money

of the United States of America, to the payment of which sum, well and truly to be made

and done, we do bind ourselves, our heirs, executors, administrators, successors and

assigns, jointly and severally, firmly by these presents.

DATED this _____ day of _____ A. D., 2024

WHEREAS: The above bounden Principal has entered into a contract with the Town of

Sharon, dated _____ day of _____ A. D., 2024

for

NOW THEREFORE, THE CONDITION of this obligation is such, that if the Principal

shall promptly make payments to all claimants as hereinafter defined, for all labor

performed or furnished and for all materials and equipment furnished for or used in or in

connection with the work called for by said AGREEMENT and/or contract and any

modifications thereof, including lumber used but not incorporated in said work, and for

the rental or hire of vehicles, tools and other appliances and equipment furnished for our

used in connection with said work, this obligation shall be void; otherwise it shall remain

in full force and effect, subject however, to the following conditions:

1. A claimant is defined as one having a direct contract with the Principal or with a subcontractor of the Principal for labor, materials and/or equipment used or reasonably required for use in the performance of the said work, labor and materials being construed to include that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental of equipment directly applicable to the said AGREEMENT and/or Contract and any modifications thereof.

2. The above named Principal and Surety hereby jointly and severally agree with the Awarding Authority that every claimant as herein defined, who has not been paid in full before the expiration of a period of sixty (65) days after the date on which the last of such claimant's work or labor was done or performed or materials or equipment were furnished by such claimant, may sue on this bond for the use of such claimant, prosecute the suit to final judgment for such sum or sums as may be justly due the claimant, and have execution thereon. The Awarding Authority shall not be liable for the payment of any costs or expenses of any such suit.

No suit or action shall be commenced here under by any claimant.

1. Unless claimant, other than one having a direct contract with the principal, shall have given written notice to any two of the following; The principal, the Awarding Authority, or the Surety above named, within sixty-five (65) days after such claimant did or performed the last of the work of labor, or furnished the last of the materials or equipment for which said claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the materials or equipment were furnished, or for whom the work or labor was done or performed. Such notice shall be served by mailing the same by registered mail or certified mail, postage prepaid, in an envelope addressed to the Principal, Awarding Authority or Surety at any manner in which the said Work is located, save that such a service need not be made by a public officer:
2. After the expiration of one (1) year following the date on which the Principal ceased work on said AGREEMENT and/or Contract and any modifications thereof, it being understood, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof, such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by law.
3. Other than in a state court of competent jurisdiction in and for the county or other political subdivision of the state in which the said work, or any part thereof, is situated, or in the United States district court for the district in which the said work, or any part thereof, is situated and not elsewhere.

The amount of this bond shall be reduced by and to extent of any payment of payments made in good faith here under, inclusive of the payment by Surety of mechanics; liens which may be filed or record against AGREEMENT and/or contract of said Work, whether or not claim for the amount of such lien be presented under and against this bond.

The surety, for value received, agrees further that not changes in, omissions from, or alterations, modifications or additions to the terms and provisions of said AGREEMENT and/or Contract or the Work to be performed there under, and that no extensions of time given or changes made in the manner or time of making payments there under, shall in any way affect the Surety's obligations on this Bond, and the surety hereby waives notice of any changes, omissions, alterations, modifications, additions or extensions

IN TESTIMONY WHEREOF and said PRINCIPAL AND SURETY had hereunto set their hands and seals and caused these presents to be duly executed the day and year above written.

(Principal)

By: _____
(Surety)

By: _____

SAMPLE

**Board of Selectmen
Policy Number Eleven**

Insurance Requirements for Independent Contractors

I. PURPOSE:

To establish criteria regarding the satisfaction of insurance requirements for independent contractors. In the past and in the absence of insurance requirements, the Town has been held liable for the workers' compensation insurance requirements and has been assessed a premium for this coverage. This policy has been exposed to risk from the actions of independent contractors. This policy will alleviate the exposure from this risk.

II. STATUTORY BACKGROUND:

Mass. General Laws, Chapter 152, provides the statutory requirements for compliance to the Commonwealth's workers' compensation.

1. Commercial General Liability including Products/Completed Operations, with no exclusion for explosion, collapse and underground damage (xcu) and including Contractual Liability to support indemnification clause in this contract. *ISO forms GC 20 10 01 and CG 20 37 01 or their equivalent must be included and attached to all certificates of insurance. The general liability policy will be written on an occurrence base form with no deductible. Coverage shall include per project aggregate and state in the certificate of insurance. Coverage shall be primary and non-contributory.*

Combined Single Limit for Bodily Injury and Property Damage
\$1,000,000 Each Occurrence
\$2,000,000 Aggregate

2. Automobile Liability (owned, non-owned and hired)
\$1,000,000 Each Occurrence. *Coverage shall be primary and non-contributory. Coverage should include pollution (MCS-90) Endorsement.*
3. Umbrella Liability – *An umbrella policy limit of no less than \$5,000,000 shall be required.*

\$5,000,000 Each Occurrence
\$5,000,000 Annual Aggregate
\$5,000,000 Products Completed Operations Aggregate

4. Workers Compensation Insurance including Waiver of Subrogation
Statutory Benefits-State of Hire
Employers Liability
\$1,000,000 Each Person for Injury by Disease
\$1,000,000 Policy Limit for Injury by Disease
-

\$1,000,000 Each Person for Injury by Accident

5. *Not used.*
6. Coverage must be written with carriers rated as A or better by Best's Rating Service or equivalent.
7. *The certificate should name the Town of Sharon its agents, employees, representatives and volunteers must be named as additional insureds with respects to the general liability, commercial automobile, and excess/umbrella policies. with respect to claims resulting from work performed by the contractor. Waiver of Subrogation shall apply to all policies. The certificate should also indicate that in the event of cancellation of any of the policies, 30 days prior written notice of cancellation will be given to the Town of Sharon*
8. *Builders' Risk coverage will be required by the contractor for full completed valuation including renovations and existing structures. Builder's risk policy will include the Town of Sharon as a named insured on the policy.*
9. *Property Insurance Coverage shall be provided by the Contractor including contractors' equipment coverage at replacement cost values (if available) to extend to Contractor.*
10. *Professional Liability coverage should be provided (if applicable) with limits no less than \$1,000,000 per claim and in the aggregate.*

D. Indemnity insurance

See page 7 of this bid regarding indemnification.

AFFIDAVIT OF COMPLIANCE

__MASSACHUSETTS BUSINESS CORPORATION__ FOREIGN (non-Massachusetts)
CORPORATION

__NON-PROFIT CORPORATION

I, _____, President

Clerk of _____

Name of Corporation

whose principal office is located _____

do hereby certify that the above named corporation has filed with the State Secretary all certificates and annual reports required by Chapter 156B, Section 109 (business corporation), by Chapter 181, Section 4 (foreign corporation), or by Chapter 180, Section 26A, (non-profit corporation) of the Massachusetts General Laws.

SIGNED UNDER THE PAINS AND PENALTIES OF PERJURY THIS _____ day of _____, 20____.

Signature of Responsible Corporate Officer _____

CERTIFICATE OF AUTHORITY

(For Corporations Only)

_____,2024
(current date)

At a meeting of the Directors of the _____duly called and
(name of corporation)

held at _____ on the _____ day of
_____,20____, at which a quorum was present and acting, it was

VOTED, that _____ the
(name)

_____of this corporation, is hereby authorized and empowered to
(office)

make, enter into, sign, seal and deliver in behalf of this corporation a contract for

(describe service)

with the Town of Sharon, and a performance bond and labor and materials bond in connection with said contract.

I do hereby certify that the above is a true and correct copy of the record, that said vote has not been amended or replaced and is in full force and effect as of this date, and

that _____ is the duly elected _____ of
(name) (office)

this corporation.

Attest:

(Affix Corporate Seal Here)

Clerk (Secretary) of the Corporation

STATEMENT OF WAGE RATE COMPLIANCE

_____, 20, _____

I, _____
(Name of signatory party) (Title)

do hereby state:

That I pay or supervise the payment of the persons employed by _____ on the
(contractors, subcontractors of public body)

(Building or Project)

and that all mechanics and apprentices, teamsters, chauffeurs and laborers employed on said project shall be paid in accordance with wages determined under the provision of Sections twenty-six (26) and twenty-seven (27) of Chapter one hundred and forty-nine (149) of the General Laws.

Signature _____

Title _____

(Signed under penalties of perjury as provided for under Section 273 of Chapter 149, General Laws)

Note: Statement to be completed by Contractor on Contractor's letterhead.

**STATEMENT OF INDEPENDENT CERTIFIED
PUBLIC ACCOUNTANT - (g. I. C. 30 39'R(C))**

I, _____, an independent certified public accountant state that I have examined the statement of management of _____ on internal accounting controls, and express the following opinion.

1. The representations of management in response to the requirement of G. L. c 30, 39R paragraph (c) are consistent with the result of management's evaluation of the system of internal account controls; and
2. Such representations of management are, in addition, reasonable with respect to transactions and assets in amounts which would be material when measured in relation to the applicant's financial statements.

Signed: _____

Title: _____

Dated: _____

**CONTRACTOR'S CERTIFICATION AS TO INTERNAL
ACCOUNT CONTROLS (G. L. c. 30, 39R(c))**

I, _____ do hereby state:
(name of signatory party) (title)

The system of internal accounting controls of this company and its subsidiaries reasonably assure the following:

1. transactions are executed in accordance with management's general and specific authorization;
2. transactions are recorded as necessary
 - i. to permit preparation of financial statements in conformity with generally accepted accounting principals, and
 - ii. to maintain accountability for assets;
3. access to assets is permitted only in accordance with management's general of specific authorization; and
4. the recorded accountability for assets is compared with the existing assets at reasonable intervals and appropriate action was taken with respect to any difference.

Signature _____

Title _____

Dated: _____

TOWN OF SHARON, MASSACHUSETTS
DEPARTMENT of PUBLIC WORKS
Sharon Water Department Water Building Renovation Project

NOTICE TO PROCEED

TO: _____ DATE: _____

You are hereby notified to commence Work in accordance with the Agreement dated _____, 2024, on or before _____, 2024.

OWNER: Town of Sharon, MA

Department of Public Works:

BY: Eric Hooper

TITLE: Superintendent, Department of Public Works

ACCEPTANCE OF NOTICE

Receipt of the above Notice To Proceed

is hereby acknowledged by

this the _____ day of _____, 2024

BY: _____

TITLE: _____

APPENDIX A:
TECHNICAL SPECIFICATIONS

**TECHNICAL SPECIFICATIONS FOR
SHARON WATER DEPARTMENT WATER BUILDING RENOVATION
PROJECT**

Please refer to “Instructions to Bidders” on page 2 of this bid document for information on required paperwork to be completed for filing a bid on this project. The following information in this “Appendix A” includes the technical specifications of the bid.

All work on the project shall be complete in every respect and in conformance with all applicable requirements of the governing laws and codes, including the Massachusetts Building, Plumbing, Electrical and Fire Codes.

All work must be approved by the Town Engineer and the Project Architect. All permit fees will be waived but insurance and bonding will be required as per bid specifications.

NOTE: All bids must include an hourly rate for change orders for carpentry, electrical, painting and masonry work. All change orders must be approved by the Town Engineer or his assignee. See “Summary Sheet – Schedule of Prices” to place hourly rate in your bid category.

All materials shall be installed in accordance with the manufacturer’s instructions.

All work must conform to the International Building Code 2015 with current Massachusetts Amendments and the other latest applicable codes.

The winning bidder should be fully licensed with the following minimum requirements:

Massachusetts Construction Supervisor’s license
DCAMM Certification
Must be in compliance with all requirements within M.G.L c. 149

The winning bidder will obtain all necessary permits related to work to be done but fees will be waived.

Contractor shall be responsible for all safety measures needed during the work on the MPCs property. Note, pursuant to G.L. c. 30, § 39S all contractor personnel employed on the work site must have completed a course in construction safety and health approved by the U.S. Occupational Safety and Health Administration (OSHA), and must provide the Town of Sharon with documentation of such successful completion with the first payroll report for each employee.

Any defects in the structure found during demo phase that should be fixed must be brought to the Owner’s attention. If the Owner decides to proceed with a repair as a change order, then a cost value will be determined prior to work being done and approved or rejected by the Owner. If there cannot be an arrangement made, an outside contractor may be hired to accomplish the change order task. Work will be performed at the change order rate provided by the bidder in the “Schedule of Prices”.

Payment Schedule:

Payments to be made in the following manner: 1) Payment when materials are delivered to the site. 2) Payment upon completion of removal and repointing of each side when

side completed. 3) The last of the balance on the contract to be paid upon satisfactorily completing the job as written in the contract, including all Add/Alt items, if applicable.

PROJECT MANUAL

SHARON WATER BUILDING

5 Upland Road
Sharon, Massachusetts

CONSTRUCTION DOCUMENTS
SEPTEMBER 19, 2023

KSID LLC
1749 Central Street, Suite 2
Stoughton, MA
781.436.3518
www.ksid.net

PROJECT MANUAL
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Section 013301	Substitution Request Form
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DIVISION 03 – CONCRETE (Not Used)

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APPENDICES

To be determined

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SECTION 00300

FORM FOR GENERAL BID

To the **Town of Sharon**, 90 South Main Street, Sharon, Massachusetts 02067 (hereinafter called "Owner"):

A. The Undersigned proposes to furnish all labor and materials required for **The Town of Sharon Water Building Renovation** in Sharon, Massachusetts, in accordance with the accompanying plans and specifications prepared by KSID, LLC and Elevated Design Inc. for the contract price specified below, subject to additions and deductions according to the terms of the specifications.

B. This bid includes addenda numbered:

No. _____ Dated: _____

No. _____ Dated: _____

C. The proposed contract price for:
The Town of Sharon Water Building Renovation

_____dollars

(\$ _____)

D. The undersigned agrees that, if he is selected as general contractor, he will within five days, Saturdays, Sundays and legal holidays excluded, after presentation thereof by the awarding authority, execute a contract in accordance with the terms of this bid and furnish a performance bond and also a labor and materials or payment bond, each of a surety company qualified to do business under the laws of the commonwealth and satisfactory to the awarding authority and each in the sum of the contract price, the premiums for which are to be paid by the general contractor and are included in the contract price; provided, however, that if there is more than 1 surety company, the surety companies shall be jointly and severally liable..

E. The undersigned hereby certifies that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the work; that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee; and that he will comply fully with all laws and regulations applicable to awards made subject to section 44A.

F. The undersigned bidder hereby certifies, under the pains and penalties of perjury, that the foregoing bid is based upon the payment to laborers to be employed on the project of wages in an amount no less than the applicable prevailing wage rates established for the project by the Massachusetts Department of Labor and Industries. The undersigned bidder agrees to indemnify

the awarding authority for, from and against any loss, expense, damages, actions or claims, including any expense incurred in connection with any delay or stoppage of the project work, arising out of or as a result of (1) the failure of the said bid to be based upon the payment of the said applicable prevailing wage rates or (2) the failure of the bidder, if selected as the contractor, to pay laborers employed on the project the said applicable prevailing wage rates.

G. The undersigned further certifies under the penalties of perjury that this bid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used in this subsection the word "person" shall mean any natural person, joint venture, partnership, corporation or other business or legal entity. The undersigned further certifies under penalty of perjury that the said undersigned is not presently debarred from doing public construction work in the commonwealth under the provisions of section twenty-nine F of chapter twenty-nine, or any other applicable debarment provisions of any other chapter of the General Laws or any rule or regulations promulgated thereunder.

Respectfully submitted:

Date: _____

By: _____
(Signature)

(Name of Bidder)

(SEAL - if bid is by
a corporation)

(Title)

(Business Address)

(City and State)

SECTION 00306

FORM FOR SUB-BID

To **The Town of Sharon**, 90 South Main Street, Sharon, Massachusetts 02067 (hereinafter called "Owner"):

PREPARATION OF SUB-BIDS

A. Work of the Sub-Contractor:

TRADE: _____

of the Specifications and in any plans specified in such SECTION, prepared by Elevated Design Inc., 1212 Hancock Street, Suite 120E, Quincy, MA 02169 and KSID, LLC, 1749 Central Street, Suite 2, Stoughton, MA 02072, for the **Town of Sharon Water Building Renovation**, for the Contract Sum of:

_____ Dollars (In Words)

\$ _____ (In Numbers)

The Sub-Bid includes Addenda numbered: _____

B. This Sub-Bid:

May be used by any General Bidder, except _____

May be used only by the following General Bidders _____

[To exclude General Bidders, insert "X" in one box only, and fill in the blank following that box. Do not answer B if no General Bidders are excluded.]

C. The undersigned agrees that, if he is selected as the Sub-Bidder, he will within five (5) days, Saturdays, Sundays, and legal holidays excluded, after presentation of a Sub-Contract by the General Contractor, execute with such General Bidder a Sub-Contract in accordance with the terms of his sub-bid and contingent upon the execution of the General Contract and, if requested so to do in the General Bid by

such General Bidder, who shall pay the premiums therefore, furnish a performance bond, also a labor and materials or payment bond, each of a surety company qualified to do business under the laws of the Commonwealth and satisfactory to the Awarding Authority and each in the sum of the Contract Price. Performance and labor and materials payment bonds shall be T-Listed; Surety company(ies) shall be listed in the U.S. Treasury Department Circular 570, most recent edition, as amended.

- D. The names of all persons, firms and corporations furnishing to the undersigned labor or labor and materials for class or classes, or part thereof, of work for which the provisions of the specifications for this sub-trade require a listing in this paragraph, (including the undersigned if customarily furnished by persons on his own payroll and in the absence of a contrary provision in the specifications), the name of each sub class of work, or part thereof, and the bid price for each such class of work or part thereof are:

Name:	Class of Work:	Bid Price:

- E. The undersigned further agrees to be bound to the General Contractor by the terms of the hereinbefore described plans, specifications, including all general conditions stated therein, and addenda, and to assume toward him all the obligations and responsibilities that he, by those documents, assumes toward the Awarding Authority.
- F. The undersigned offers the following information as evidence for his qualifications to perform the work as bid upon according to all requirements of the plans and specifications:

1. Have been in business under the present business name _____ years.
2. Ever failed to complete any work awarded? _____.
3. List one or more recent buildings with names of General Contractor and Architect on which you served as Sub-Contractor for work of similar character as required for the above-named building:

BUILDING	ARCHITECT	GENERAL CONTRACTOR.	CONTACT	AMOUNT OF CONTRACT
				\$ _____
				\$ _____
				\$ _____

4. Bank Reference Contact Info: _____

- G. The undersigned hereby certifies that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the work and that he will comply fully with all laws and regulations applicable to awards of subcontract subject to Section 44A.

- H. The undersigned hereby certifies, under the penalties of perjury that this sub-bid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used in this subsection, the word “person” shall mean any natural person, joint venture, partnership, corporation or other business or legal entity.
- I. The undersigned further certifies under penalties of perjury that the said undersigned is not presently debarred from doing public construction work in the Commonwealth under the provisions of section twenty-nine F of chapter twenty-nine, or any other applicable debarment provisions of any other chapter of the General Laws or any rule or regulation promulgated thereunder.

DATE: _____, 2023

Name of Sub-Bidder

By: _____

Business Address

City and State

Telephone: _____

Facsimile: _____

SECTION 011000

GENERAL REQUIREMENTS

1.1	General Provisions	1.11	Submittals
1.2	Project Requirements	1.12	Warranties
1.3	Specification Information	1.13	Cutting and Patching
1.4	Definitions	1.14	Temporary Facilities and Utilities
1.5	Industry Standards	1.15	Products and Substitutions
1.6	Codes and Regulations	1.16	Delivery, Storage and Handling
1.7	Progress Schedule	1.17	Owner-Furnished (OFCL) Products
1.8	Schedule of Values	1.18	Labels
1.9	Payment Requests	1.19	Record Documents
1.10	Procedures and Controls	1.20	Project Close Out
		1.21	Final Cleaning and Repair

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

1.2 PROJECT REQUIREMENTS

- A. Project Identification: Sharon Water Building.

- B. Particular Project Requirements:

1. Requirements for sequencing, scheduling and completion date:
 - a. The existing office will be occupied during Construction.
 - b. Noise and dust partitions will be required.
 - c. Utilities for occupied spaces shall be maintained.
 - d. Protection of Owner's staff and client safety shall be maintained.

- C. Project Requirements for Temporary Utilities and Facilities:

1. Utility Costs: The Owner will allow the use of existing utility systems and pay for cost of utility services consumed, including electricity, water and gas. Do not waste. The Contractor shall provide and pay for temporary heat prior to the complete enclosure of the building and availability of suitable permanent systems.
2. Temporary Offices: A separate field office for the Architect and the Owner's Representative is not required.
3. Toilet Facilities: The Contractor shall provide and maintain temporary toilets outside the building.

- D. Permits and Fees: Apply for, obtain, and pay for permits, fees, and utility company backcharges required to perform the work. Submit copies to Architect.

GENERAL REQUIREMENTS

- E. Codes: Comply with applicable codes and regulations of authorities having jurisdiction. Submit copies of inspection reports, notices and similar communications to Architect.
- F. Dimensions: Verify dimensions indicated on drawings with field dimensions before fabrication or ordering of materials. Do not scale drawings.
- G. Existing Conditions: Notify Architect of existing conditions differing from those indicated on the drawings.
- H. Contractor's Conduct on Premises: The Contractor and their employees shall behave in a respectful, courteous and safe manner. Abusive, harassing, and lewd behavior is prohibited. Music playing is prohibited. Alcohol, tobacco, and drug use is prohibited.
 - 1. Comply with Owner's security requirements.

1.3 SPECIFICATION INFORMATION

- A. These specifications are a specialized form of technical writing edited from master specifications and contain deviations from traditional writing formats. Capitalization, underlining and bold print is only used to assist reader in finding information and no other meaning is implied.
- B. Except where specifically indicated otherwise, the subject of all imperative statements is the Contractor.
- C. Sections are generally numbered in conformance with Construction Specifications Institute Masterformat System. Numbering sequence is not consecutive. Refer to the Table of Contents for names and numbers of sections included in this Project.
- D. Pages are numbered separately for each section. Each section is noted with "End of Section" to indicate the last page of a section.

1.4 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.5 INDUSTRY STANDARDS

- A. Referenced standards are part of the Contract Documents and have the same force and effect as if bound with these specifications.
- B. Except where specifically indicated otherwise, comply with the current standard in effect as of the date of the Owner/Contractor Agreement. Obtain copies of industry standards directly from publisher.
- C. The titles of industry standard organizations are commonly abbreviated; full titles may be found in Encyclopedia of Associations or consult Architect.

1.6 CODES AND REGULATIONS

- A. Comply with all applicable codes, ordinances, regulations and requirements of authorities having jurisdiction.
- B. Submit copies of all permits, licenses, certifications, inspection reports, releases, notices, judgments, and communications from authorities having jurisdiction to the Architect.
- C. COVID-19 Procedures: The Contractor shall submit a written plan for jobsite COVID-19 Procedures in compliance with applicable governmental regulations and as supplemented by the Contractor's own requirements, if any. Scope shall include that people and materials entering the site shall be required to comply with the written plan. Identify the Contractor's personnel responsible for implementing such procedures. For the record, submit a monthly statement certifying that the Contractor has enforced the provisions in its written plan. The Contractor acknowledges that its written plan and monthly statements are submitted for the record only and not for approval by neither the Owner nor the Architect nor their agents.

1.7 PROGRESS SCHEDULE

- A. Provide comprehensive bar chart schedule showing all major and critical minor portions of the work, sequence of work and duration of each activity. Update and reissue regularly, but not less than monthly.

1.8 SCHEDULE OF VALUES

- A. Prepare Schedule of Values to coordinate with application for payment breakdown. Submit at least 10 days before first payment application. Update and reissue regularly, but not less than monthly.

1.9 PAYMENT REQUESTS

- A. Provide three copies of each request on completely filled out copies of AIA G702 and continuation sheet G703. Substantiate requests with complete documentation; include change orders to date. Provide partial lien waivers for work in progress and full lien waivers for completed work.
- B. As-Constructed Record Drawing Certification: Certify as a part of each application for payment that the project as-constructed record documents are current at the time of application is submitted. The Contractor shall require such drawings to be current as a condition of approving any payment to the trade Contractor and Subcontractor.
- C. Before first payment application, provide the following:
 - 1. List of subcontractors, suppliers and fabricators.
 - 2. Schedule of values.
 - 3. Progress schedule.
 - 4. Submittal schedule keyed to project schedule.
 - 5. List of Contractor's key project personnel.
 - 6. Copies of permits and other communications from authorities.
 - 7. Contractor's certificate of insurance.
 - 8. Performance and payment bonds if required.
 - 9. Unit price schedule.
- D. Before final payment application, provide and complete the following:
 - 1. Complete closeout requirements.
 - 2. Complete punch list items.
 - 3. Settle all claims.
 - 4. Transmit record documents to Architect. Include statement that Architect's Supplemental Instructions, Change Orders, Construction Change Directives and minor changes in the work have been incorporated in the as-constructed record drawings.
 - 5. Prove that all taxes, fees and similar obligations have been paid.
 - 6. Remove temporary facilities and surplus materials.
 - 7. Change lock cylinders or cores.
 - 8. Clean the work.
 - 9. Submit consent of surety, if any, for final payment.

1.10 PROCEDURES AND CONTROLS

- A. Project Meetings: Arrange for and attend meetings with the Architect and such other persons as the Architect requests to have present. The Contractor shall be represented by a principal, project manager, general superintendent or other authorized main office representative, as well as by the Contractor's field superintendent. An authorized representative of any subcontractor or sub-subcontractor shall attend such meetings if the representative's presence is requested by the Architect. Such representatives shall be empowered to make binding commitments on all

matters to be discussed at such meetings, including costs, payments, change orders, time schedules and manpower. Any notices required under the Contract may be served on such representatives. Written reports of meeting minutes shall be prepared by the Contractor and distributed by the Contractor to attendees, the Architect, and Owner within three business days.

1. Pre-Construction Conference: Attendance by Architect, Contractor, major subcontractors. Agenda shall include: Quality of workmanship, coordination, interpretations, job schedule, submittals, approvals, requisition procedures, testing, protection of construction, indoor air quality, and construction waste management.
 2. Exterior Envelope Meeting: Attendance by Architect, Contractor, major subcontractors. Agenda shall include as applicable: Review of exterior wall details, wall construction, sample panel preparation, cleaning, control and expansion joints, cold weather procedures.
 3. Roofing/Flashings Meeting: Attendance by Architect, Contractor, roofing subcontractor, and representative of roofing manufacturer. Agenda shall include as applicable: Preparation of roof decks, flashing and blocking details, roofing procedures and inspections, bonds and guarantees, weather conditions during roofing, protection of roof membrane during construction.
 4. Interior Finishes Meeting: Attendance by Architect, Contractor, major subcontractors. Agenda shall include as applicable: Quality of workmanship, environmental conditions for application of finishes, drywall details, millwork details, condition of surfaces to receive finishes, tile work, painting work, samples and test areas and approvals, coordination with mechanical and electrical interfaces and penetrations, indoor air quality.
 5. Progress Meetings: Hold regularly before preparation of payment requests and additional meetings as requested by the Architect. Attendance by Architect, Contractor, and others as determined by Contractor. Agenda shall include work in progress and payment requests.
 6. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction, as specified. Preinstallation Conferences may be part of Progress Meeting agenda. Attendance by Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow. Agenda shall include a review of progress of other construction activities and preparations for the particular activity under consideration.
- B. Emergency Contacts: Furnish the Owner and Architect, in writing, the names and telephone numbers of individuals to be contacted in the event of an out-of-hours emergency at the building site. Post a similar list readily visible from the outside of the field office or a location acceptable to the Architect.
- C. Layout: Layout work and be responsible for all lines, elevations, and measurements of the building, grading, utilities and other work executed under the contract. Retain a registered professional engineer or registered land surveyor, acceptable to the Architect, to initially establish exterior lines and required elevations of all buildings and structures to be erected on the site. The registered professional engineer or registered land surveyor shall certify the actual location of the constructed facilities in relation to property lines, building lines, easements, setbacks, and other restrictive boundaries.
- D. Field Measurements: Verify measurements at the building prior to ordering materials or commencing work. No extra charge or compensation will be allowed because of differences between actual dimensions and measurements indicated on the Drawings. Differences which may be found shall be submitted to the Architect for decision before proceeding with the work.

- E. Field Measurements for Fixed Equipment: Dimensions for fixed equipment to be supplied under this Contract or separate contracts shall be determined by field measurements taken jointly by the Contractor and the equipment supplier involved. A record of the field measurements shall be kept until time of substantial completion of the project, or until the equipment has been fully installed and accepted by the Owner, whichever is later. Responsibility for fixed equipment fabricated accurately to field measurements for proper fit and operation shall be that of the Contractor. Contractor shall pay all costs involved in correcting any misfitting fixed equipment as fabricated.
- F. Project Limit Line: The boundaries of the site do not limit the responsibility of the Contractor to perform the work in its entirety. Make utility connections as indicated.
- G. Matching: Where matching is indicated, the Architect shall be the sole and final judge of what is an acceptable match. Mockups and sample submissions are required.
- H. Observation: Notify the Architect and authorities having jurisdiction at least thirty-six hours in advance of concealing any work.
- I. Utilities: Prior to interrupting utilities, services or facilities, notify the utility owner and the Owner and obtain their written approval a minimum 48 hours in advance.
- J. Furnishings, Fixtures, and Equipment: Cooperate and permit the Owner to install their furnishings and equipment during the progress of the work. Owner's installation of furnishings or equipment does not signify Owner's acceptance of any portion of the work.
- K. Clean-Up: Frequently clean-up all waste, remove from site regularly, and legally dispose of off-site.
 - 1. Comply with requirements of Section 017400 - CONSTRUCTION WASTE MANAGEMENT.
- L. Installer's Acceptance of Conditions: All installers shall inspect substrates and conditions under which work is to be executed and shall report in writing to the Contractor all conditions detrimental to the proper execution and completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means installer accepts previous work and conditions.
- M. Coordination: The Contractor shall be fully responsible for coordinating all trades, coordinating construction sequences and schedules, and coordinating the actual installed location and interface of all work.
 - 1. Prior to beginning mechanical, electrical and fire protection work, the Contractor shall prepare coordination drawings showing the exact alignment, physical location and configuration of the mechanical, electrical and fire protection installations and demonstrating to the Contractor's satisfaction that the installations will clear all obstructions, permit proper clearances for the Work of other trades, and present an orderly appearance where exposed. The Contractor shall be solely liable and responsible for any costs and delays resulting from the Contractor's failure to prepare such coordination drawings or from the negligent preparation of such coordination drawings.
 - 2. Exact locations and groupings of mechanical, electrical and fire protection fixtures, switches, heads and outlets shall be obtained from the Architect before the Work is

roughed in. Work installed without such information from the Architect shall be relocated at the Contractor's expense if the Architect so requests.

N. Request For Interpretation (RFIs):

1. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
 - a. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
2. Content of the RFI: Include a detailed, legible description of item needing interpretation.
3. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow three working days for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.
4. The following RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. Incomplete RFIs or RFIs with numerous errors.

- O. Existing Articles of Unusual Value: If during demolition, excavation, or disposal work articles of unusual value or of historical or archaeological significance are encountered, the ownership of such articles is retained by the Owner, and information regarding their discovery shall be immediately furnished to the Architect. If the nature of the article is such that work cannot proceed without danger of damage, work in the area shall be immediately discontinued until the Architect has determined the proper procedure to be followed. Delays in time thereby shall be a condition for which the time of the Contract may be extended. Costs incurred after discovery in the salvaging of such articles shall be borne by the Owner.

1.11 SUBMITTALS

- A. Required Submittals: Submit shop drawings, product data, initial selection samples, verification samples, calculations, coordination drawings, schedules, and all other submittals as specified in individual specification sections.
- B. Submittal Schedule: Within 30 days after award of contract and before first application for payment, prepare list of submittals in chronological sequence showing all submittals and proposed date first due at Architect's office and proposed date due to be returned to Contractor. Note relevant specification section number.
- C. Contractor's Preparation of Submittals: Modify and customize all submittals to show interface with adjacent work and attachment to building. Identify each submittal with name of project, date, Contractor's name, subcontractor's name, manufacturer's name, submittal name, relevant specification section numbers, and Submittal Schedule reference number. Stamp and sign each submittal to show the Contractor's review and approval of each submittal before delivery to Architect's office; unstamped and unsigned submittals will be returned without action by the Architect. Leave 4" x 6" open space for Architect's "action" stamp.

1. Electronic Submittals: Provide a copy of all submittals in electronic format to the Architect. Architect will return a file of reviewed submittal in electronic format to the Contractor for distribution to subcontractors, suppliers, fabricators, governing authorities and others as necessary for proper performance of the Work. Unless otherwise amenable to the Architect, additional hard copies of submittals will not be reviewed by the Architect (or Consultant) and will not be returned to the Contractor.
 2. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 3. Name file with submittal number or other unique identifier, including revision identifier.
 4. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect and Construction Manager.
 5. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Architect.
- D. Product Data: Provide manufacturer's preprinted literature including, without limitation, manufacturer's standard printed description of product, materials and construction, recommendations for application and use, certification of compliance with standards, instructions for installation, and special coordination requirements. Collect data into one submittal for each unit of work or system; mark each copy to show which choices and options are applicable to project.
1. Installer Copy: Verify that the Installer has a current copy of the relevant product data, including installation instructions, before permitting installation to begin.
- E. Shop Drawings: Provide accurately prepared, large scale and detailed shop drawings prepared specifically for this project. Show adjacent conditions and related work. Show accurate field dimensions and clearly note field conditions. Identify materials and products in the work shown. Note special coordination required.
1. After Architect's action, follow specified distribution procedure.
- F. Samples: Provide units identical with final materials and products to be installed in the work. Where indicated, prepare samples to match Architect's sample. Label each sample with description, source, generic name or manufacturer's name and model number. Architect will review samples for confirmation of visual design intent, color, pattern, texture and type only; Architect will not test samples for compliance with other Contract requirements which shall remain the exclusive responsibility of the Contractor.
1. Initial Selection Samples Submittal Quantities: For initial selection purposes, submit 1 set of samples showing the complete range of colors and finishes available.
 2. Verification Samples Submittal Quantities: For verification of an initial selection, submit 3 sets of samples; one set will be returned to Contractor to be maintained at project site for quality control comparisons.
- G. Timing of Submittals: Submit submittals in a timely fashion to allow at least 10 business days for each office's review and handling. This means that submittals which have to be reviewed by the Architect and one of their consultants require at least 20 business days for review and handling. Add ten business days for each additional consultant who must review a submission.
- H. Architect's Action on Submittals: Architect will review submittals, stamp with "action stamp", mark action, and return to Contractor. Architect will review submittals only for conformance with the design concept of the project. The Contractor is responsible for confirming compliance with

other Contract requirements, including without limitation, performance requirements, field dimensions, fabrication methods, means, methods, techniques, sequences and procedures of construction, coordination with other work. The Architect's review and approval of submittals shall be held to the limitations stated in the Owner/Architect Agreement and the Conditions of the Contract. In no case shall approval or acceptance by the Architect be interpreted as a release of Contractor of their responsibilities to fulfill all of the requirements of the Contract Documents.

1. Required Resubmittal: Unless submittal is noted "reviewed" or "reviewed except as noted, resubmission not required," make corrections or changes to original and resubmit to Architect.
2. Distribution: When submittal is noted "reviewed" or "reviewed as noted, resubmittal not required," make prints or copies and distribute to Owner, Subcontractors involved, and to all other parties requiring information from the submittal for performance or coordination of related work.

1.12 WARRANTIES

- A. Warranties Required: Refer to individual trade sections for specific product warranty requirements.
- B. Procurement: Where a warranty is required, do not purchase or subcontract for materials or work until it has been determined that parties required to countersign warranties are willing to do so.
- C. Warranty Forms: Submit written warranty to Owner through Architect for approval prior to execution. Furnish two copies of executed warranty to Owner for their records; furnish two additional conformed copies where required for maintenance manual.
- D. Work Covered: Contractor shall remove and replace other work of project which has been damaged as a result of failure of warranted work or equipment, or which must be removed and replaced to provide access to work under warranty. Unless otherwise specified, warranty shall cover full cost of replacement or repair, and shall not be pro-rated on basis of useful service life.
- E. Warranty Extensions: Work repaired or replaced under warranty shall be warranted until the original warranty expiration date or for ninety days whichever is later in time.
- F. Warranty Effective Starting Date: Guarantee period for all work, material and equipment shall begin on the date of substantial completion of the Project, not when subcontractor has completed their work nor when equipment is turned on. In addition to the one year guarantees for the entire work covered by these Contract Documents, refer to the various sections of the specifications for extended guarantee or maintenance requirements for various material and equipment.
- G. Warranties are Irrevocable: Warranties issued to the Owner are irrevocable.
 1. Non-Payment: If warrantor refuses to issue warranty, or attempts to revoke warranty due to lack of payment by any party other than the Owner, the Contractor shall resolve the payment conflict, and cause the warranty to be issued or reinstated.
 2. Incomplete or incorrect Installation: If warrantor refuses to issue warranty, or attempts to revoke warranty due to improper installation or other deficiency, the Contractor shall correct the deficiency and cause the warranty to be issued or reinstated.

- H. Transferable Warranties: All warranties shall permit Owner to transfer or assign warranties to future owners or other assignors at no additional cost to the Owner for the full warranty period.

1.13 CUTTING AND PATCHING

- A. Limitations: Do not cut and patch any work in a manner that would result in a failure of the work to perform as intended, decreased energy performance, increased maintenance, decreased operational life, or decreased safety.
 - 1. Structural Work: Do not cut structural work or bearing walls without written approval from Architect. Where cutting and patching of structural work is necessary and approved by Architect, perform work in a manner which will not diminish structural capacity nor increase deflection of member. Provide temporary shoring and bracing as necessary. Ensure the safety of people and property at all times.
- B. Cutting and Patching Materials: Use materials identical to materials to be cut and patched. If identical materials are not available or cannot be used, use materials that match existing materials to the greatest extent possible. Provide finished work that will result in equal to or better than existing performance characteristics.
- C. Inspection: Before cutting and patching, examine surfaces and conditions under which work is to be performed and correct unsafe and unsatisfactory conditions prior to proceeding.
- D. Protection: Protect adjacent work from damage. Protect the work from adverse conditions.
- E. Cutting: Cut work using methods least likely to damage adjoining work. Use tools designed for sawing or grinding, not hammering or chopping. Use saws or drills to ensure neat, accurately formed holes to sizes required with minimum disturbance to adjacent work. Temporarily cover openings; maintain weathertightness and safety.
 - 1. Utilities: Locate utilities before cutting. Provide temporary utilities as needed. Cap, valve, or plug and seal ends of abandoned utilities to prevent entrance of moisture or other foreign matter.
- F. Patching: Patch with seams and joints which are durable and not visible. Comply with specified tolerances for similar new work; create true even planes with uniform continuous appearance. Restore finishes of patched areas and, if necessary, extend finish restoration onto adjoining unpatched area to eliminate evidence of patching and refinishing. Repaint entire assemblies, not just patched area. Remove and replace work which has been cut and patched in a visually unsatisfactory manner as determined by the Architect.
- G. Qualifications: Retain experienced and specialized firms, original installers if possible, to perform cutting and patching. Workmen shall be skilled in type of cutting and patching required.

1.14 TEMPORARY FACILITIES AND UTILITIES

- A. Scope of Temporary Work: This article is not intended to limit the scope of temporary work required under the Contract. Provide all temporary facilities and utilities needed.
- B. Permits and Fees: Obtain and pay for all permits, fees and charges related to temporary work.

- C. Codes and Authorities Having Jurisdiction for Temporary Facilities and Utilities: Comply with all requirements of authorities having jurisdiction, codes, utility companies, OSHA, and industry standards including, but not limited to the following:
1. NFPA 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations.
 2. ANSI-A10 Series, Safety Requirements for Construction and Demolition.
 3. NECA National Joint Guideline NJG-6, Temporary Job Utilities and Services.
 4. Electrical Service: NEMA, NECA, and UL.
- D. Field Offices: Provide Contractor's field offices as needed. Keep current copies of all Contract Documents and project paperwork neatly on file at jobsite. Permit Architect's unrestricted use of Contractor's field office facilities including copiers, telephones, plan tables, and other equipment. Furnish, maintain, and pay for light, power, phone, fax, and other field office services.
- E. Shops and Sheds: At Contractor's option, provide shops and sheds for Contractor's use as needed. Locate shops and sheds where acceptable to Owner and authorities having jurisdiction. Prior to completion of construction, temporary storage facilities and surplus stored materials shall be removed from the site.
- F. Weather Protection: It is the intent of these Specifications to require that the Contractor shall provide temporary enclosures and heat to permit construction work to be carried on during the months of November through March. Under no circumstances shall the Contractor suspend any work during the months of November through March because of their reluctance to provide and pay for temporary weather protection. These Specifications are not to be construed as requiring enclosures or heat for operations that are not economically feasible to protect in the judgment of the Architect. Included in the preceding category, without limitation, are such items as site work, excavation, steel erection, erection of certain "exterior" wall panels, roofing, and similar operations.
1. 'Weather Protection' shall mean the temporary protection of that work adversely affected by moisture, wind, and cold, by covering, enclosing and/or heating. This protection shall provide adequate working areas during the months of November through March consistent with the approved construction schedule to permit the continuous progress of all work necessary to maintain an orderly and efficient sequence of construction operations. The Contractor shall furnish and install all "weather protection" material and be responsible for all costs, including heating required to maintain a minimum temperature of 55 degrees F. at the working surface. This provision does not supersede any specific requirements for methods of construction, curing of materials or the applicable general conditions set forth in the Contract with added regard to performance obligations of the Contractor.
 2. Within 30 calendar days after his award of contract, the Contractor shall submit in writing to the Architect for approval, his proposed methods for "Weather Protection."
 3. Installation of weather protection and heating devices shall comply with all safety regulations including provisions for adequate ventilation and fire protection devices. Heating devices which may cause damage to finish surfaces shall not be used.
- G. Heating During Construction: Within 30 calendar days after the commencement of work under this Contract, the Contractor shall submit in writing to the Architect for approval, the Contractor's method and time schedule for heating during construction which shall concur with his general progress schedule.

1. After the building or portion thereof is completely enclosed by either permanent construction or substantial temporary materials having a comparable resistance as the specified permanent construction, The Contractor shall pay and provide heat therein of not less than 55 degrees F., nor more than 75 degrees F., which shall be continuously maintained in the enclosed area to the extent necessary to properly progress and protect the work until the project is accepted.
 2. The Contractor shall furnish and install one accurate recording Fahrenheit thermometer at a place acceptable to the Architect, and one additional accurate thermometer for every 2,000 square feet of floor space, located as directed by the Architect in order to determine if the specified temperatures are maintained. The Contractor or his authorized agent shall furnish daily to the Architect a signed statement of temperatures recorded every three hours.
 3. The Contractor, with the approval of the Architect, may use the permanent heating system as specified for the project once it has been tested, flushed out and chemically treated, thoroughly cleaned of all construction dust and dirt, and is ready to operate. The Contractor shall pay all energy costs for heating during construction and provide meters if required. The Contractor and the HVAC and/or Electrical subcontractor shall coordinate their work so that the permanent heating system for the building will be available and ready to provide heat as soon as the building is closed in. In case the Contract includes more than one building, the heating shall be provided for each building in accordance with the above provision. The guarantee period for equipment shall not start until the equipment is turned over to the Owner for their use. Do not invalidate existing warranty by any action or failure to act. Clean and change air filters frequently to prevent construction dust and debris from contaminating system.
 4. Operating labor shall be provided for continuous direct attendance, for frequent inspection of the system, emergency repairs, and keeping of temperature records. Continuous direct attendance shall mean direct attendance for twenty-four hours each day, seven days per week, Saturdays, Sundays and holidays included, throughout the progress of the work.
 5. It shall be the sole responsibility of the Contractor to arrange for and pay the HVAC and/or Electrical subcontractor to operate and to put in first-class condition all portions of the permanent heating system used for heating during construction.
 6. If the system is electric heat, the foregoing requirements shall equally apply to all the comparable components thereof.
 7. The installation and operation of heating devices shall comply with all safety regulations including provisions for adequate ventilation and fire protection. Heating devices which may cause damage to finish surfaces shall not be used.
- H. Pumping and Drainage: Protect excavations, trenches, buildings and materials from rain water, ground water, backup or leakage of sewers, drains and other piping, and from water of any other origin. Promptly remove any accumulation of water. Provide and operate all pumps, piping and other equipment necessary for pumping, drainage and protection from water.
- I. Equipment and Tools: Provide all equipment including, but not limited to, hoists, lifts, scaffolding, machines, tools and the like, as needed for execution of the work. Provide safe access to all parts of the work.
- J. Temporary Enclosures: Provide temporary enclosures to maintain proper temperatures and to prevent weather damage. Always maintain legal means of egress.
- K. Snow and Ice: Remove all snow and ice which interferes with work or safety.

- L. Streets, Walks and Grounds: Maintain public and private roads and walks clear of debris caused by construction operations. Repair all damage caused to streets, drives, curbs, sidewalks, fences, poles and similar items where disturbed or damaged by building construction and leave them in as good condition after completion of the work as before operations started.
- M. Protection: Protect nearby property and the public from construction activities. Provide and maintain barricades, warning signs and lights, railings, walkways and similar items. Immediately repair damaged property to its condition before being damaged.
- N. Public Services: Provide temporary public services such as, street lighting, night lighting, sidewalks, covered passages, signs, signals and the like, as requested by authorities having jurisdiction.
- O. Construction Fencing: Provide construction fencing and barriers as applicable to the project and as required by code to protect personnel, the public, and to control access.
- P. Security: Secure site against unauthorized entry at all times. Provide secure, locked temporary enclosures. Protect the work at all times. Provide watchman service, if necessary, to protect the work.
- Q. Signs: Erect project identification signs in compliance with details to be provided by Architect. Signs shall be minimum 4' x 8' exterior grade plywood and shall contain the names of the project, Owner, Architect, major Consultants, Contractor, and major financing institution. Except for safety and warning signs, no other signs are permitted. Location as acceptable to the Architect.
- R. Fire Prevention: Take every precaution to prevent fire. Provide and maintain in good operating condition suitable and adequate fire protection equipment and services, and comply with recommendations regarding fire protection made by the representative of the fire insurance company carrying insurance on the Work or by the local fire chief or fire marshal. The area within the site limits shall be kept orderly and clean, and all combustible rubbish shall be promptly removed from the site.
- S. Egress: Maintain safe and legal means of egress at all times. At all times, provide at least two separate means of egress.
- T. Mold Control and Remediation During Construction: The Contractor shall protect construction materials and building systems from moisture damage and from conditions which promote mold growth during and after construction. The Contractor shall be responsible for mold remediation and replacement of materials which cannot be successfully remediated in accordance with the following requirements:
 - 1. Materials which become wet prior to installation shall be cleaned, treated and dried in accordance with EPA Guidelines.
 - 2. Materials which exhibit mold growth prior to installation shall not be installed and shall be removed from the site.
 - 3. Materials which exhibit mold growth after installation shall be remediated in accordance with EPA Guidelines for Remediating Building Materials with Mold Growth Caused by Clean Water. The Contractor shall engage and pay for a qualified industrial hygienist acceptable to the Owner to determine the cause of the mold growth, and to certify in writing that materials have been successfully remediated. In the event that the industrial hygienist recommends methods of remediation in addition to those in the Guidelines, the

Contractor shall also be responsible for the additional remediation. Materials which can not be successfully remediated shall be removed and replaced with new materials at no additional expense to the Owner.

4. Prior to the start of construction, the Contractor shall submit the name of the person in the Contractor's organization responsible for ensuring compliance with these requirements for mold control and remediation.

- U. Existing Mold-Contaminated Materials: In the event that mold-contaminated materials are encountered during remodeling operations, the Contractor shall stop work in that area and notify the Owner and Architect in writing. The Owner will engage and pay for an industrial hygienist to evaluate the situation to advise the Contractor on the proper course of action.

1.15 PRODUCTS AND SUBSTITUTIONS

- A. Specified Products: In all cases in which a manufacturer's name, trade name or other proprietary designation is used in connection with materials or articles to be furnished under this Contract, whether or not the phrase "or equal" is used after such name, the Contractor shall provide the product of the named manufacturers without substitution, unless a written request for a substitution has been submitted by the Contractor and approved in writing by the Architect.
- B. Deviations from Detailed Requirements: If the Contractor proposes to use material which, while suitable for the intended use, deviates in any way from the detailed requirements of the Contract Documents, the Contractor shall inform the Architect in writing of the nature of such deviations at the time the materials is submitted for approval, and shall request written approval of the deviation from the requirements of the Contract Documents.
- C. Approval of Substitutions: In requesting approval of deviations or substitutions, the Contractor shall provide evidence, including, but not limited to manufacturer's data, leading to a reasonable certainty that the proposed substitution or deviation will provide a quality of result at least equal to that attainable if the detailed requirements of the Contract Documents were strictly followed. If, in the opinion of the Architect, the evidence presented by the Contractor does not provide a sufficient basis for such reasonable certainty, the Architect may reject such substitution or deviation without further investigation.
- D. Intent of Contract Documents: The Contract Documents are intended to produce a building of consistent character and quality of design. All components of the building including visible items of mechanical and electrical equipment have been selected to have a coordinated design in relation to the overall appearance of the building. The Architect shall judge the design and appearance of proposed substitutes on the basis of the suitability in relation to the overall design of the Project, as well as for their intrinsic merits. The Architect will not approve as equal to materials specified proposed substitutes which in the Architect's opinion, would be out of character, obtrusive, or otherwise inconsistent with the character or quality of design of the Project. In order to permit coordinated design of color and finishes the Contractor shall furnish the substituted material in any color, finish texture, or pattern which would have been available from the manufacturer originally specified, at no additional cost to the Owner.
- E. Additional Costs or Impact: Any additional cost, or any loss or damage arising from the substitution of any material or any method for those originally specified shall be borne by the contractor, notwithstanding approval or acceptance of such substitution by the Owner or the Architect, unless such substitution was made at the written request or direction of the Owner and the Architect. Any decrease in the cost of the substitution shall be returned to the Owner.

- F. Manufacturers: To the greatest degree possible, provide primary materials and products from one manufacturer for each type or kind. Provide secondary materials as recommended by manufacturers of primary materials.
- G. Substitution Requests: Refer to Section 016200 - SUBSTITUTION REQUEST FORM. Submit 3 copies. Identify product to be replaced by substitute by reference to specification sections and drawing numbers. Provide Contractor's certification and evidence to prove compliance with Contract Document requirements as acceptable to Architect.
- H. Substitution Conditions: Substitution requests will be returned without action unless one of the following conditions is satisfied. The Contractor shall state which of the following conditions applies to the requested substitution:
 - 1. Request is due to an "or equal" clause.
 - 2. Specified material or product cannot be coordinated with other work.
 - 3. Specified material or product is not acceptable to authorities having jurisdiction.
 - 4. Substantial advantage is offered Owner in terms of cost, time, or other valuable consideration.
 - 5. Specified material or product is not available.
- I. Invalid Substitutions: Contractor's submittal and Architect's acceptance of shop drawings, samples, product data or other submittal is not a valid request for, nor an approval of a substitution unless the Contractor presents the information when first submitted as a Request for Substitution.
- J. Compatibility of Materials Used in the Work:
 - 1. Ensure complete compatibility between materials.
 - 2. Compatibility shall include adhesion, erosion, solubility, differential thermal response, and galvanic action.
 - 3. Provide evidence of compatibility.
 - 4. Provide custom testing where evidence is not available.
 - 5. Where materials are not compatible, provide necessary isolation or transition materials and provide details of same.
 - 6. Correct defects resulting from incompatibility including de-construction and re-construction of assemblies – whether materials are part of a submittal and substitution process or not.
 - 7. Proposed substitutions may be rejected where compatibility information is not provided; or where compatibility is not adequately addressed, according to the Architect's judgment; or where incompatible materials would negatively impact the project's success.

1.16 DELIVERY, STORAGE AND HANDLING

- A. Manufacturer's Instructions: Strictly comply with manufacturer's instructions and recommendations and prevent damage, deterioration and loss, including theft. Minimize long-term storage at the site. Maintain environmental conditions, temperature, ventilation, and humidity within range permitted by manufacturers of materials and products used.
- B. Labels, Trademarks, & Tradenames: Locate required labels on inconspicuous surfaces. Do not provide labels, nameplates, or trademarks which are not required. Provide permanent data plate on each item of equipment stating manufacturer, model, serial number, capacity, ratings and all other essential data.

1.17 RECORD DOCUMENTS

- A. Definition of As-Constructed Record Drawings: (commonly called “as-builts”) are the record of the Project as constructed based on information the Contractor provides to the Owner under the contract for construction. Because the As-constructed Record Drawings will be based on the Contractor’s mark-ups, the Architect is not responsible for the accuracy or completeness of the As-constructed Record Drawings.
- B. Definition of As-Designed Record Drawings: The record of everything the Architect designed for the Project, and including the original Construction Documents plus all addenda, Architect’s Supplemental Instructions, Change Orders, Construction Change Directives and minor changes in the work.
- C. General: Keep as-constructed record documents neatly and accurately. Record information as the work progresses and deliver to Architect at time of final acceptance. Include in record documents all field changes made, all relevant dimensions, and all relevant details of the work. Keep record documents up to date with all Architect’s Supplemental Instructions, Change Orders, Construction Change Directives and minor changes in the work clearly indicated.
- D. Drawings: Keep four separate sets of blackline prints at the site, one set each for mechanical, electrical, plumbing, and architectural/structural disciplines. Neatly and accurately note all deviations from the Contract Documents and the exact actual location of the work as installed. Marked-up and colored prints will be used as a guide to determine the progress of the work installed. Requisitions for payment will not be approved until the record documents are accurate and up-to-date.
 - 1. Work Outside Building: Record data outside of building to an accuracy of plus or minus 1 inch and determine and record the invert elevation of all drain lines.
 - 2. At completion of the work, submit one complete set of marked-up as-built prints for review. After acceptance, these marked-up as-built prints shall be used in the preparation of the as-built drawings.
 - 3. Architect shall furnish Contractor with AutoCAD or BIM Design Intent Model or both files for originals of the Contract Drawings. The Contractor shall make modifications to these files as shown on the marked-up prints. Remove superseded data to show the completed installation.
 - 4. The Contractor shall deliver the completed AutoCAD or BIM Design Intent Model or both as-constructed record drawings, in the same version as Contract Drawings, properly titled and dated to the Architect. Indicate preparer of as-built drawings. These as-built drawings shall become the property of the Owner.
- E. Specifications: Maintain one clean copy of complete specifications including addenda, modifications, and bulletins with changes, substitutions, and selected options clearly noted. Circle or otherwise clearly indicate which manufacturer and products are actually used.
- F. Operating and Maintenance Manuals: Manuals shall be submitted which contain the following:
 - 1. Description of the system provided.
 - 2. Handling, storage, and installation instructions.
 - 3. Detailed description of the function of each principal component of the systems or equipment.
 - 4. Operating procedures, including prestartup, startup, normal operation, emergency shutdown, normal shutdown and troubleshooting.

5. Maintenance procedures including lubrication requirements, intervals between lubrication, preventative and repair procedures, and complete spare parts list with cross reference to original equipment manufacturer's part numbers.
 6. Control and alarm features including schematic of control systems, control loop electric ladder diagrams, controller operating set points, settings for alarms and shutdown systems, pump curves and fan curves.
 7. Safety and environmental considerations.
- G. Copies of Operating and Maintenance Manuals: Three copies of the manuals shall be provided within sufficient time to allow for training of Owner's personnel. Submit one copy of the manuals to the Architect for review no later than 90 calendar days prior to substantial completion, or building turn over, whichever comes first. Submit the remaining five copies within 15 days after first review set is returned to contractor. Progress payment may be withheld if this requirement is not met.
- H. Additional Requirements for Operating and Maintenance Manuals: The requirements for manuals applies to each packaged and field-fabricated operating system. The manuals shall be provided in three-ring side binders with durable plastic covers. The manuals shall contain a detailed table of contents and have tab dividers for major sections and special equipment.
- I. Instructions for Owner's Personnel: Prior to final inspection, instruct the Owner's personnel in operation, adjustment and maintenance of products, equipment and systems. Provide instruction at mutually agreed upon times. Video all instruction sessions and deliver videos to Owner on thumb drive or other suitable media.
1. For equipment that requires seasonal operation provide similar instruction during other seasons.
 2. Use operation and maintenance manuals for each piece of equipment or system as the basis of instruction. Review contents in detail to explain all aspects of operation and maintenance.
- J. Framed Data: Provide charts and lists of all valves, circuits, switches, controls and equipment. Install on walls under glass at locations directed by Architect.

1.18 PROJECT CLOSE OUT

- A. Complete the following prior to Substantial Completion:
1. Provide Contractor's Punch List of incomplete items stating reason for incompleteness and value of incompleteness.
 2. Advise Owner of insurance change over requirements.
 3. Submit all warranties, maintenance contracts, final certificates and similar documents.
 4. Obtain Certificate of Occupancy and similar releases which permit the Owner's full and unrestricted use of the areas claimed "Substantially Complete".
 5. Submit record documents.
 6. Deliver maintenance stocks of materials where specified.
 7. Make final change over of lock cylinders or cores and advise Owner of change of security responsibility.
 8. Complete startup of all systems and instruct Owner's personnel in proper operation and routine maintenance of systems and equipment.
 9. Complete clean up and restoration of damaged finishes.
 10. Remove all temporary facilities and utilities that are no longer needed.

11. Request Architect's inspection for Substantial Completion.
- B. Architect will either issue a Certificate of Substantial Completion or notify Contractor of work which must be performed prior to issue of certificate.
- C. Complete the following prior to Final Acceptance and payment:
 1. Obtain Certificate of Substantial Completion.
 2. Submit final application for payment, showing final accounting of changes in the work.
 3. Provide final releases and lien waivers not previously submitted.
 4. Submit certified copy of final punch list stating that Contractor has completed or corrected each item.
 5. Submit final meter readings, record of stored fuel and similar information.
 6. Submit Consent of Surety for final payment.
 7. Submit evidence of Contractor's continuing insurance coverage (if required by Contract Documents).

1.19 FINAL CLEANING AND REPAIR

- A. Clean Up: Immediately prior to the Architect's inspection for Substantial Completion, the Contractor shall completely clean the premises and clean and prepare the completed work in order for it to be used for its intended purpose in accordance with the Contract Documents. Such work shall include, but not be limited to the following:
 1. Concrete and ceramic surfaces shall be cleaned and washed.
 2. Resilient coverings shall be cleaned, waxed and buffed as applicable.
 3. Woodwork shall be dusted and cleaned.
 4. Sash, fixtures and equipment shall be thoroughly cleaned.
 5. Stains, spots, dust, marks and smears shall be removed from all surfaces.
 6. Hardware and metal surfaces shall be cleaned and polished.
 7. Glass and plastic surfaces shall be thoroughly cleaned by professional window cleaners.
 8. Damaged, broken or scratched glass or plastic shall be replaced by the Contractor at the Contractor's expense.
 9. Vacuum carpeted and soft surfaces with high efficiency particulate arrestor (HEPA) vacuum.
 10. Use low-emitting, environmentally friendly cleaning agents and procedures. Do not use ammonia-, chlorine bleach-, or solvent-based cleaners, unless authorized in writing by Architect.
- B. Pest Control: Engage a licensed exterminator, who practices integrated pest management (IPM), to inspect the project and eliminate rodents, termites and all other insects and pests. Coordinate pest control plan with Owner. Owner's written approval is required prior to application. Submit proposed program to Owner and Architect. Program shall clearly indicate the following:
 1. Area or areas to be treated.
 2. Manufacturer's printed instructions and MSDS for each chemical to be used.
 3. Pollution preventive measures to be employed.
- C. Repairs: Repair and touch-up all damaged and deteriorated products and surfaces.

SHARON WATER BUILDING
SHARON, MA

KSID, LLC
SEPTEMBER 19, 2023

PART 2 - PRODUCTS [Not Used]

PART 3 - EXECUTION [Not Used]

END OF SECTION

SECTION 012200

UNIT PRICES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. This Section covers those items for which indefinite quantities can be expected and, therefore, pre-agreed prices per unit of work are established as means to determine adjustments to the Contract Price after actual quantities are determined.

1.3 QUANTITIES AND COST ADJUSTMENTS

- A. Refer to individual Specification Sections for methods of measurement and payment for unit prices. As soon as the work involved in each unit cost item has been completed, submit documentation to establish the actual quantities provided. Submit to the Architect for review and issuance of Change Order.
- B. Change Order amount for each unit cost item will be based on actual quantities multiplied by the unit price. This unit price includes all costs as described below.

1.4 UNIT PRICES

- A. Should certain additional work be required, or should the quantities of certain classes of work be increased or decreased from those required by the Contract Documents, by authorization of the Owner, the below unit prices shall, at the option of the Owner, be the basis of payment to the Contractor or credit to the Owner, for such increase or decrease in the work.
- B. The Unit Prices shall represent the exact net amount per unit to be paid the Contractor (in the case of additions or increases) or to be refunded the Owner (in the case of decreases). No additional adjustment will be allowed for materials, installation, substrate preparation, overhead, profit, insurance, general conditions, or other direct or indirect expenses of the Contractor or Subcontractors.

PART 2 - PRODUCTS [Not Used]

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

- A. As defined by the Architect.

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SHARON, MA

KSID, LLC
SEPTEMBER 19, 2023

END OF SECTION

UNIT PRICES
012200 - 2

SECTION 012300

ALTERNATES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. For each of the alternates Scheduled at the end of this Section, state the amount in the proposal to be added to or deducted from the Contract Sum for the work.

1.3 ALTERNATES

- A. Definition: "Alternates" are alternate products, materials, equipment, systems, methods, units of work or major elements of the construction, which may, at the Owner's option and under the terms established by the Contract or Agreement, be selected for the work in lieu of the corresponding requirements of the Contract Documents. Selection may occur prior to the Contract Date, or may, by the Agreement, be deferred for possible selection at a subsequent date.
- B. Alternate Requirements: A Schedule of Alternates is included at the end of this Section. Each alternate is defined using abbreviated language, recognizing that the Contract Documents define the requirements. Coordinate related work to ensure that work affected by each alternate is complete and properly interfaced with work of each selected alternate.
- C. Provide written proposals for each alternate on the Bid Form for Owner's consideration. Each proposal amount shall include the entire cost of the alternate portion of the work including overhead, profit, and other costs including cost of interfacing and coordinating the alternate with related and adjacent work.
- D. Selection of Alternates: Selection of alternates to be included in the work will be by the Owner.
- E. Notification: Immediately following award of Contract, prepare and distribute to each entity a notification of status of each alternate. Indicate which alternates have been accepted, rejected, or deferred for consideration at a later date. Include full description of negotiated modifications to alternates, if any

PART 2 - PRODUCTS [Not Used]

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate No. 1: Add Alternate: TBD.

END OF SECTION

SECTION 013301

SUBSTITUTION REQUEST FORM

No substitutions will be considered without this completed substitution request form and supporting documentation. Substitutions made without completion of this form will be considered defective work as stated in AIA A201.

Date: _____

Number: _____

Re: Request for Substitution

The Contractor proposes the following substitution in accordance with the requirements of the Contract Documents:

Scope of Substitution _____

Specification Reference _____

Drawing Reference _____

Reason for Proposed Substitution _____

Benefit to Owner _____

Impact on Project Cost _____

Impact on Project Schedule _____

Impact on Guarantees and Warranties _____

Coordination and Compatibility Required with Adjacent Materials and System _____

List Deviations
From Specified
Requirements

Attachments: Attach supporting documentation sufficient for Architect to evaluate substitution.
Substitution Request Forms submitted without adequate documentation will be returned without review.

Attachments

Response Date: List date by which response by Architect is requested to maintain project schedule and allow sufficient time for inclusion of proposed substitution.

Response Date

Submitted By

Firm and Address

Signature below signifies acceptance of responsibility for accuracy and completeness of information included in this Substitution Request Form.

Authorized Signature

ARCHITECT'S RESPONSE

Notations listed below shall have same meaning as on Architect's approval stamp. Clarifications to or changes in project schedule or time shall be processed using standard project forms.

Architect's
Response

- _____ Approved
- _____ Approved as Corrected
- _____ Revise and Resubmit
- _____ Rejected
- _____ Returned Without Review

Remarks

Date

Signed

END OF FORM

SECTION 01 74 00

CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. This Section includes requirements for the Contractor's implementation of waste management controls and systems for the duration of the Work.
- B. Develop a waste management plan, quantifying material diversion by either weight or volume to recycle and/or salvage non-hazardous construction and demolition debris.

1.3 INTENT

- A. The Owner and Architect have established that this Project shall generate the least amount of waste practical and that processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors shall be employed.
- B. With regard to these goals the Contractor shall develop, for the Architect's review, a Construction Waste Management Plan (CWMP) for this Project.
- C. Each Subcontractor shall be responsible for segregating his own waste into different dumpsters as directed by the Contractor.
- D. Contractor shall be responsible for ensuring that debris will be disposed of at appropriately designated licensed solid waste disposal facilities, as defined by MGL Chapter 111, Section 150A.

1.4 SUBMITTALS

- A. Waste Management Plan (WMP): Submit within 21 calendar days after receipt of Notice to Proceed, in a format acceptable to the Owner.
 - 1. Analysis of the proposed jobsite waste to be generated, including types and rough quantities.
 - 2. Landfill Options: The name of the landfills where trash and building debris will be disposed of, the applicable landfill tipping fees, and the projected cost of disposing of all Project waste in the landfills.
 - 3. Landfill Certification: Contractor's statement of verification that landfills proposed for use are licensed for types of waste to be deposited and have sufficient capacity to receive waste from this project.

4. Alternatives to Landfilling: A list of each material proposed to be salvaged or recycled during the course of the Project. Include the following and any additional items proposed:
 - a. Cardboard and paper products.
 - b. Clean dimensional wood.
 - c. Beverage containers.
 - d. Concrete.
 - e. Slurry wall materials.
 - f. Bricks and masonry.
 - g. Asphalt.
 - h. Metals from framing, banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
 - i. Mechanical and electrical equipment.
 - j. Building components which can be removed relatively intact from existing construction.
 - k. Packaging materials, including cardboard, boxes, plastic sheet and film, polystyrene packaging, wood crates, plastic pails.
 - l. Glass.
 - m. Scraps from new gypsum wall board.
 - n. Carpet and pad.
 - o. Acoustical ceiling panels.
 - p. Plastics.
 5. Meetings: A description of the regular meetings to be held to address waste management.
 6. Materials Handling Procedures: A description of the means by which any waste materials identified above will be protected from contamination, and a description of the means to be employed in recycling the above materials consistent with requirements for acceptance by designated facilities.
 7. Transportation: A description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site) and destination of materials.
- B. Waste Management Progress Reports: Concurrent with each Application for Payment, submit a written Waste Management Progress Report in the same format as required for Final Report.
- C. Waste Management Final Report: Prior to Substantial Completion, submit a written Waste Management Final Report summarizing the types and quantities of materials recycled and disposed of under the Waste Management Plan. Include the name and location of disposal facilities.
1. Material category.
 2. Generation point of waste.
 3. Total quantity of waste, by weight.
- D. Other Submittals:
1. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
 2. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

3. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, and/or receipts.
4. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, and/or receipts.
5. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.5 CONTRACTORS

- A. Contractor may subcontract work of this Section to a sub-contractor specializing in recycling and salvaging of construction waste.
- B. Gypsum Wallboard Recycling: New, paper-faced gypsum wallboard scrap (cuts from construction - not demolition waste) generated at project shall be recycled. Keep scrap dry.
- C. Acoustical Ceiling Panel Recycling: Demolition and construction waste pulpable mineral fiber ceiling panels may be recycled by Armstrong World Industries and US Gypsum. Contact Armstrong at 1-877-ARMSTRONG (1-877-276-7876) or www.armstrong.com or contact USG at 1-800-USG-4YOU or www.usg.com, to coordinate recycling efforts, apply for product approvals, and receive reclamation procedure requirements.
- D. Carpet Recycling: Demolition and construction waste carpet and carpet padding may be recycled by Carpet America Recovery Effort (CARE). Visit www.carpetrecovery.org to locate carpet reclaimers in local project area and reclamation procedure requirements.

PART 2 - PRODUCTS [Not Used]

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement Waste Management Plan as approved by the Architect. Provide containers, storage, signage, transportation, and other items as required to implement WMP for the entire duration of the Contract.

3.2 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. Manager: The Contractor shall designate an on-site person responsible for instructing workers and overseeing and documenting results of the Waste Management Plan for the Project.
- B. Distribution: The Contractor shall distribute copies of the Waste Management Plan to the Job Site Foreman, each Subcontractor, the Owner and the Architect.
- C. Instruction: The Contractor shall provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the Project.

- D. Separation Facilities: The Contractor shall lay out and label a specific area to facilitate separation of materials for recycling, salvage, reuse, and return. Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials. Location shall be acceptable to the Architect.

- E. Hazardous Wastes: Any unforeseen hazardous wastes shall be separated, stored, and disposed of according to local, state and federal regulations.

END OF SECTION

SECTION 024100

DEMOLITION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included:

1. Demolition and removal of selected portions of buildings and structures and as required for new work. Refer to the Drawings for additional requirements.
2. Salvage of existing items to be reused or turned over to the facility.
3. Removal and legal disposal of demolished materials off site. Except those items specifically designated to be relocated, reused, or turned over to the facility, all existing removed materials, items, trash and debris shall become property of the Contractor and shall be completely removed from the site and legally disposed of at their expense. Salvage value belongs to the Contractor. On-site sale of materials is not permitted.
4. Demolition and removal work shall properly prepare for alteration work and new construction to be provided under the Contract.
5. Scheduling and sequencing operations without interruption to utilities serving occupied areas. If interruption is required, obtain written permission from the utility company and the Owner.

- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 011000 - GENERAL REQUIREMENTS for temporary facilities and controls, for maintenance of access, for cleaning during construction, and for dust and noise control.
2. Section 017400 - CONSTRUCTION WASTE MANAGEMENT for waste management and recycling.
3. Section 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL:
 - a. Waste management and recycling.
4. Division 22 - PLUMBING:
 - a. Disconnecting, capping and otherwise making inactive existing plumbing services in areas where demolition and removal work is required.
 - b. Disconnection and reinstallation of plumbing equipment temporarily interrupted during construction.
5. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING:

- a. Disconnecting, capping and otherwise making inactive existing HVAC services in areas where demolition and removal work is required.
 - b. Disconnect and reinstallation of HVAC equipment temporarily interrupted during construction.
6. Division 26 - ELECTRICAL WORK:
- a. Disconnecting, capping and otherwise making inactive existing electrical services in areas where demolition and removal work is required.
 - b. Disconnect and reinstallation of electrical equipment temporarily interrupted during construction.
7. Section 311000 – SITE CLEARING:
- a. Excavating and removal of existing pavement, sub-surface building and utility structures and lines, appurtenances, and other elements indicated on the Drawings.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to the Owner ready for reuse, at a location designated by the Owner. Protect from weather until accepted by Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated. Protect from weather until reinstallation.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain property of the Owner as applicable. Carefully remove each item or object in a manner to prevent damage and deliver promptly to a location acceptable to the Owner.

1.5 SUBMITTALS

- A. Schedule of Selective Demolition Activities: Indicate the following:
 1. Detailed sequence of selective demolition and removal work, with early and late starting and finishing dates for each activity. Ensure Owner's on-site operations are uninterrupted if applicable.
 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 3. Coordination for shutoff, capping, and continuation of utility services.
 4. Use of elevator and stairs.

5. Locations of proposed dust- and noise-control temporary partitions and means of egress, including for other occupants affected by selective demolition operations.
 6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
 7. Means of protection for items to remain and items in path of waste removal from building.
- B. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged, and turned over the Owner.
- C. Predemolition Video and Pictures: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Comply with Division 01 requirements. Submit before Work begins.

1.6 QUALITY ASSURANCE

- A. Examination of Existing Conditions: The Contractor shall examine the Contract Drawings for demolition and removal requirements and provisions for new work. Verify all existing conditions and dimensions before commencing work. The Contractor shall visit the site and examine the existing conditions as he finds them and shall inform herself/himself of the character, extent and type of demolition and removal work to be performed. Submit any questions regarding the extent and character of the demolition and removal work in the manner and within the time period established for receipt of such questions during the bidding period.
- B. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Standards: Comply with ANSI A10.6 and NFPA 241.
- E. Predemolition Conference: Conduct conference at Project site to comply with requirements in Section 011000 - GENERAL REQUIREMENTS, Project Meetings. Review methods and procedures related to selective demolition including, but not limited to, the following:
1. Inspect and discuss condition of construction to be selectively demolished.
 2. Review structural load limitations of existing structure.
 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 5. Review areas where existing construction is to remain and requires protection.

1.7 WARRANTY

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

PART 2 - PRODUCTS

2.1 SALVAGING

- A. Salvaged for Reinstallation: Materials indicated on the Drawings to be salvaged and reinstalled shall be carefully removed and stored at a location acceptable to the Architect and Owner.
- B. Salvaged for Storage: Materials indicated on the Drawings or designated in the field by the Owner to be salvaged and stored shall be carefully removed and delivered to the Owner at locations determined by Owner.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Engage a professional engineer registered in the state that the project is located to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.
- F. Survey of Existing Conditions: Record existing conditions by use of preconstruction videotapes.
 - 1. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.
- G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Arrange to shut off indicated utilities with utility companies and Owner.
 - 2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.
4. Prior to commencing cutting work in existing surfaces, take all precautionary measures to assure that mechanical and electrical services to the particular area have been made inactive. Coordinate with Fire Suppression, Plumbing, HVAC, and Electrical subcontractors. Only licensed tradesmen of that particular trade shall disconnect and cap existing mechanical and electrical items that are to be removed, abandoned and/or relocated.
5. If, during the process of cutting work, existing utility lines are encountered which are not indicated on the Drawings, regardless of their condition, immediately report such items to the Architect. Do not proceed with work in such areas until instructions are issued by the Architect. Continue work in other areas.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Comply with requirements for access and protection specified in Section 011000 - GENERAL REQUIREMENTS, Temporary Facilities and Controls.
 2. Maintain adequate passage to and from all exits at all times. Before any work is done which significantly alters access or egress patterns, consult with the Architect and obtain approval of code required egress. Under no condition block or interfere with the free flow of people at legally required exits, or in any way alter the required condition of such exits.
- B. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 1. Strengthen or add new supports when required during progress of selective demolition.
 2. Remove temporary shoring, bracing and structural supports when no longer required.
 3. Post warning signs and place barricades as applicable during placement and removal of temporary shoring.
- C. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around demolition area(s).
 1. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction. Provide temporary barricades as required to limit access to demolition areas.
 2. Protect existing site improvements, appurtenances, and landscaping to remain.

3.4 SELECTIVE DEMOLITION, GENERAL

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

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 9. Maintain clear unimpeded passage through the work area for safety and emergency egress.
 10. Saw cut overruns in concrete and masonry for new door, window and other finish openings is not permitted. Core drill corners and finish square to match required opening.
 11. Dispose of demolished items and materials promptly.
 - a. Comply with requirements in Section 017400 - CONSTRUCTION WASTE MANAGEMENT.
- B. Removed and Salvaged Items:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to storage area designated by the Owner.
 5. Protect items from damage during transport and storage.
- C. Removed Items for Reinstallation by the Respective Trade.
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to storage area designated by the Owner.
 5. Protect items from damage during transport and storage.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

E. Items for Re-use and Preservation of Existing Surfaces to Remain:

1. The Contractor shall inspect closely each item specifically designated to be relocated, re-used, or turned over to the Owner prior to its removal, and immediately report damages and defects to the Architect and the Owner. The Contractor shall be responsible for any subsequent damage to the same other than latent defects not readily apparent from close inspection, and shall bear responsibility for its repair or same replacement as directed by the Architect, to the satisfaction of the Owner.
2. Unless special surface preparation is specified under other Specification Sections, leave existing surfaces that are to remain in a condition suitable to receive new materials and/or finishes.

3.5 PROTECTION OF PUBLIC AND PROPERTY

- A. Provide all measures required by federal, state and municipal laws, regulations, and ordinances for the protection of surrounding property, the public, workmen, and Owner's employees during all demolition and removal operations. Measures are to be taken, but not limited to installation of sidewalks, sheds, barricades, fences, warning lights and signs, trash chutes and temporary lighting.
- B. Protect all walks, roads, streets, curbs, pavements, trees and plantings, on and off premises, and bear all costs for correcting such damage as directed by the Architect, and to the satisfaction of the Owner.
- C. Demolition shall be performed in such a manner that will insure the safety of adjacent property. Protect adjacent property from damage and protect persons occupying adjacent property from injuries which might occur from falling debris or other cause and so as not to cause interference with the use of other portions of the building, of adjacent buildings or the free access and safe passage to and from the same.
- D. Every precaution shall be taken to protect against movement or settlement of the building, of adjacent buildings, sidewalks, roads, streets, curbs and pavements. Provide and place at the Contractor's own expense, all necessary bracing and shoring in connection with demolition and removal work.
- E. Remove portions of structures with care by using tools and methods that will not transfer heavy shocks to existing and adjacent building structures, both internal and external of the particular work area.
- F. Provide and maintain in proper condition, suitable fire resistive dust barriers around areas where interior demolition and removal work is in progress. Dust barriers shall prevent the dust migration to adjacent areas. Remove dust barriers upon completion of major demolition and removal in the particular work area.

3.6 DISCOVERY OF HAZARDOUS MATERIALS

- A. If hazardous materials, such as chemicals, asbestos-containing materials, or other hazardous materials are discovered during the course of the work, cease work in affected area only and immediately notify the Architect and the Owner of such discovery. Do not proceed with work in such areas until instructions are issued by the Architect. Continue work in other areas.

- B. If unmarked containers are discovered during the course of the work, cease work in the affected area only and immediately notify the Architect and the Owner of such discovery. Do not proceed with work in such areas until instructions are issued by the Architect. Take immediate precautions to prohibit endangering the containers integrity. Continue work in other areas.

3.7 CUTTING

- A. Perform all cutting of existing surfaces in a manner which will ensure a minimal difference between the cut area and new materials when patched. Use extreme care when cutting existing surfaces containing concealed utility lines which are indicated to remain and bear full responsibility for repairing or replacement of all such utilities that are accidentally damaged.
- B. Provide a flush saw cut edge where pavement, curb and concrete removals abut new construction work or existing surfaces to remain undisturbed.
- C. All slurry and water shall be contained and managed to avoid damage to existing conditions when using a wet saw or wet core driller.
- D. Obtain and pay for a hot work permit and arrange to have on-site a Fire Watch when using a cutting torch or similar item.

3.8 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Comply with requirements of Section 017400 - CONSTRUCTION WASTE MANAGEMENT and the following:
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.

3.9 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Premises shall be left in a clean condition and ready to accept alteration work and new construction.

END OF SECTION

SECTION 049500
ABRASIVE BLASTING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Abrasive blasting of interior brick, to remove existing coatings, dirt, and miscellaneous stains and to create uniform finished surfaces.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 099000 - PAINTING AND COATINGS for paints applied to abrasive blasted substrates.

1.3 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Qualification Data: For Applicator.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in abrasive blasting similar substrates, whose work has resulted in applications with a record of successful in-service performance.
- B. Mock-ups: Before beginning primary work of this section, provide mock-ups at locations acceptable to Architect and obtain Architect's acceptance of visual qualities. Protect and maintain acceptable mock-ups throughout the work of this section to serve as criteria for acceptance of this work.
 - 1. Produce mock-up area for each different type of material and surface to be cleaned.
 - 2. Provide 3' x 6' interior abrasive blasting mock-ups to show techniques used and results obtained. Provide mock-ups on each type of substrate encountered, including but not limited to the following:
 - a. Interior brick wall as directed by Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
 - 1. Product name or title of material.
 - 2. Product description (generic classification or binder type).
 - 3. Manufacturer's stock number and date of manufacture.
 - 4. Contents by volume, for pigment and vehicle constituents.
 - 5. Application instructions.
 - 6. VOC content.

- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.
 - 1. Protect from freezing. Keep storage area neat and orderly.

PART 2 - PRODUCTS

2.1 ABRASIVE BLASTING EQUIPMENT AND MATERIALS

- A. Abrasives: Walnut shells. Materials with hardness factors exceeding 3-4 (such as Black Beauty, sand, glass) will not be accepted.

- B. Masking: Masking and barriers to prevent exfiltration of abrasives and residues shall be 6 mil thick reinforced PVC sheet applied with nailers and duct tape or other approved method.

- C. Wetting Agent: Wetting agent for removal of spent abrasives and dust shall be "The Wetting Edge", manufactured by Wilbur and Williams Division of California Products, Dustreat by Water Technologies, ZHP by Water Wetters, or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for conditions affecting performance of abrasive blasting system.

3.2 EXECUTION

- A. Use materials and techniques used on approved sample panels (mock-ups). Beginning work means Installer accepts substrates and conditions.

- B. Perform work in a manner to result in uniform final appearance. Use the least destructive means and methods available. Avoid destroying existing surfaces. Do not cut out mortar. Do not change masonry or wood shapes nor round masonry edges. Do not gouge wood surfaces. Provide uniform fine texture on masonry and wood surfaces. Do not create fuzzy wood surfaces by heavy, destructive abrasive blasting.

1. Adequately protect adjacent surfaces that are not scheduled for abrasive blasting, including wood window components and trim.
- C. During operations, isolate the spaces being abrasive blasted from adjoining areas.
 - D. Brush and vacuum all interior surfaces including those which have been cleaned by abrasive blasting or abrasive blasting to remove all traces of abrasive blasting abrasives and removed materials.
- 3.3 FIELD QUALITY CONTROL
- A. The Contractor shall establish and maintain throughout the work of this section, an effective quality control program to ensure that work is performed as required by the Contract Documents. Establish specific procedures to ensure uniform cleaning and final appearance exactly matching approved mock-ups.

END OF SECTION

SECTION 055000
METAL FABRICATIONS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following. Requirements for materials, hot-dip galvanizing, and shop-applied primers are included with each item as applicable.
 - 1. Steel framing and supports for applications where framing and supports are not specified in other Sections; galvanized at exterior locations and in exterior walls.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 099000 - PAINTING AND COATING for field painting work of this section.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design miscellaneous framing and supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Thermal Movements: Provide exterior metal fabrications that 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 connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.4 SUBMITTALS

- A. Product Data: For each product.
- B. Shop Drawings: Show fabrication and installation details for metal fabrications.
 - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
 - 2. Provide templates for anchors and bolts specified for installation under other Sections.

- 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 professional engineer responsible for their preparation.
- D. Welding certificates.
- E. Qualification Data: For professional engineer.

1.5 QUALITY ASSURANCE

- A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal fabrications that are similar to those indicated for this Project in material, design, and extent.
- C. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.3, "Structural Welding Code--Sheet Steel."
- D. 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.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
 - 2. Provide allowance for trimming and fitting at site.

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

- C. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 FERROUS METALS

- A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. 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.
- D. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- E. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
- F. Slotted Channel Framing: Cold-formed metal channels with continuous slot complying with MFMA-4.
 - 1. Basis of Design: Unistrut Corp.
- G. Cast Iron: ASTM A 48/A 48M, Class 30, unless another class is indicated or required by structural loads.

2.2 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.
- B. Anchor Bolts: ASTM F 1554, Grade 36. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.
- C. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.
- D. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488,

conducted by a qualified independent testing agency. Anchors shall have an ICC-ES report with approval for use in cracked concrete.

1. Acceptable Manufacturers: Kwik-Bolt TZ by Hilti, Inc., TruBolt Wedge Anchor by ITW Red Head, Power-Stud+ by Powers Fasteners, or Strong Bolt by Simpson.

E. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.3 MISCELLANEOUS MATERIALS

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

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Zinc-Rich Primer: Urethane zinc-rich primer compatible with topcoat Specified in Section 099000 - PAINTS AND COATINGS.

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

- a. Carboline; Carbozinc 585.
- b. Tnemec; Series 394 PerimePrime.
- c. ZRC Zero-VOC Galvanizing.

2. VOC Content: 250 g/L or less.

D. Galvanizing Repair Paint: High-zinc-dust-content (95% by weight) paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

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

- a. Aervoe Low VOC Cold Galvanizing Coating.
- b. Duncan Galvanizing; ZiRP.
- c. ZRC Worldwide; Galvilite Galvanizing Repair, low VOC type.

2. VOC Content: 250 g/L or less.

E. Isolation Coating (Bituminous Paint): ASTM D 1187, cold-applied asphalt emulsion, VOC compliant, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
 - 1. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dayton Superior; 1107 Advantage Grout.
 - b. Sika; SikaGrout 212.
 - c. WR Meadows; CG-86 DOT.
 - 2. VOC Content: 0 g/L.

2.4 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, 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 true to line and level 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 where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be 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.

2.5 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 retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts if units are installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

2.6 FINISHES, GENERAL

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

2.7 STEEL PRIMERS AND FINISHES

- A. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
 - 1. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Urethane Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Interiors (SSPC Zone 1A): SSPC-SP 7, "Brush Off Blast Cleaning."
 - 3. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be field welded, embedded in concrete or masonry, unless otherwise indicated. Extend priming of partially embedded members to a depth of 2 inches.
 - 4. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 5. Comply with SSPC-PA 2, "Measurement of Dry Coating Thickness with magnetic Gages."
- B. Zinc-Rich Primer: Urethane zinc-rich primer compatible with topcoat Specified in Section 099000 - PAINTS AND COATINGS.
 - 1. Available Products: Tnemec; Series 394 PerimePrime, or approved equal.
 - 2. VOC Content: 340 g/L or less.

2.8 HOT-DIP GALVANIZING

- A. Hot-Dip Galvanizing: For steel exposed to the elements, weather or corrosive environments and other steel indicated to be galvanized, provide coating for iron and steel fabrications applied by the hot-dip process.

1. Basis-of-Design: Duragalv by Duncan Galvanizing.
2. Comply with ASTM A 123 for fabricated products and ASTM A 153 for hardware.
3. Provide thickness of galvanizing specified in referenced standards.
4. Galvanizing bath shall contain special high grade zinc and other earthly materials.
5. Fill vent holes after galvanizing, if applicable, and grind smooth.

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 bolts, 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 steel that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of isolation coating.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in this Section.
- C. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in this Section.
1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Touch-Up and Repair for Galvanized Surfaces: For damaged and field-welded metal coated surfaces, clean welds, bolted connections and abraded areas.
1. For galvanized surfaces, apply organic zinc repair paint complying with requirements of ASTM A 780, modified to 95 percent zinc in dry film. Thickness of applied galvanizing repair paint shall be not less than coating thickness required by ASTM A 123 or A 153 as applicable. Touch-up of galvanized surfaces with silver paint, brite paint, or aluminum paints is not acceptable.
 2. For factory-applied finish coatings, field-touch-up shall be performed by factory approved personnel. Touch-up shall be such that repair is not visible from a distance of 6 feet.
 3. A touch-up repair kit or touchup instructions shall be provided to the Owner for each type of factory-applied finish.

END OF SECTION

SECTION 061000
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. Wood blocking, cants, and nailers.
 2. Plywood backing panels.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
1. Section 042000 - UNIT MASONRY for wood nailers and blocking built into masonry.
 2. Section 061600 - SHEATHING for plywood and gypsum sheathing.
 3. Section 064020 - INTERIOR ARCHITECTURAL WOODWORK for interior woodwork not specified in this Section.
 4. Section 092110 - GYPSUM BOARD ASSEMBLIES for sheet metal backing.

1.3 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
1. Indicate component materials and dimensions and include construction and application details.
 2. 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, net amount of preservative retained, and chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
 3. 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, both before and after exposure to elevated temperatures when tested according to ASTM D 5516 and ASTM D 5664.
 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

- B. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 - 3. Provide dressed lumber, S4S, unless otherwise indicated.
 - 4. Provide dry lumber with 15 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.
- B. Plywood Panels:
 - 1. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.
 - 2. Thickness: As needed to comply with requirements specified but not less than thickness indicated.
 - 3. Factory mark panels according to indicated standard.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
 - a. Use Borate or Copper Azole treatments. Product shall not contain creosote, arsenic or pentachlorophenol.
 - 2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 18 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.

- C. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete in exterior walls.
- E. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Hoover Treated Wood Products; PyroGuard.
 - 2. Koppers Performance Chemicals; LifeWood MicroPro Treatment.
 - 3. Sustainable Northwest Wood; Pressure Treated Wood with Copper Azule.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: For all interior use materials, and where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Treatment shall not promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 - 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 - 4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841.
 - 5. Product shall not contain creosote, arsenic or pentachlorophenol.
- 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.
- E. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Technologies Boralife Inc.; Boraflame.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide FRTW lumber for support or attachment of other construction, including, but not limited to, the following: Rooftop equipment bases and support curbs, blocking, cants, nailers, furring and grounds.
- B. For items of dimension lumber size, provide Construction, Stud, or No. 2 grade lumber with 15 percent moisture content.

2.5 PANEL PRODUCTS

- A. Miscellaneous Concealed Plywood: Exposure 1 sheathing, span rating to suit framing in each location, and thickness as indicated but not less than 1/2 inch.
- B. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2 inch thick.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
- B. Nails, Wire, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A with ASTM A 563 hex nuts and, where indicated, flat washers.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below 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 per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5; except provide stainless steel complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2, where in contact with pressure-preservative treated wood or when exposed to exterior conditions.

2.7 MISCELLANEOUS MATERIALS

- A. Adhesive, Including Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
1. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Henkel Corp.; Loctite PL Premium Polyurethane Construction Adhesive.
 - b. Henkel Corp.; OSI SF450 Heavy Duty Subfloor Construction Adhesive.
 2. Low-Emitting Materials: Provide adhesives in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 3. VOC Content: 70 g/L or less.
 4. Do not use adhesives that contain urea formaldehyde.
 5. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Discard units of material with defects that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- C. Apply field treatment complying with AWWA M4 to cut surfaces of preservative-treated lumber and plywood.
- D. Securely attach carpentry work as indicated and according to applicable codes and the following:
 1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
 2. ICC-ES evaluation report for fastener.
- E. Countersink fastener heads on exposed carpentry work and fill holes with wood filler.
- F. Use fasteners of appropriate type and length. Pre-drill members when necessary to avoid splitting wood.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install as required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

END OF SECTION

SECTION 061600

SHEATHING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Subflooring.
 - 2. Underlayment.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 042000 - UNIT MASONRY for masonry-veneer anchors and insulation in cavity wall construction.
 - 2. Section 061000 - ROUGH CARPENTRY for wood framing and miscellaneous plywood backing panels.
 - 3. Section 072700 - AIR BARRIERS for modified bituminous sheet membrane over sheathing and membrane flashing.
 - 4. Section 076200 - SHEET METAL FLASHING AND TRIM for flashing applied to sheathing.

1.3 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
 - 3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
 - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - 5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Evaluation Reports: For following products, from ICC-ES:

1. Preservative-treated plywood.
2. Fire-retardant-treated plywood.
3. Power-driven fasteners.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
- B. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

1.5 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 WOOD PANEL PRODUCTS

- A. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.
- 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.

2.2 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.3 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 - 1. Use treatment that does not promote corrosion of metal fasteners.
 - 2. Exterior and Interior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 - 3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified.
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat plywood indicated on Drawings.

2.4 SUBFLOORING AND UNDERLAYMENT

- A. Plywood Subflooring: Exterior, Structural I single-floor panels or sheathing.
 - 1. Span Rating: As indicated on Structural Drawings.
 - 2. Nominal Thickness: Not less than 3/4 inch.
 - 3. Edges: Tongue and groove.
 - 4. Face: C-D plugged.

2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or Type 304 stainless steel.
 - 2. For pressure-preservative treated sheathing, provide fasteners of Type 304 stainless steel only.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

- D. Wood Screws: ASTM C 1002.
- E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
 - 1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or Type 304 stainless steel.
 - 2. For pressure-preservative treated sheathing, provide fasteners of Type 304 stainless steel only.

2.6 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.
 - 1. Adhesives shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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, as applicable:
 - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
 - 2. 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 and roof sheathing installation with air/vapor retarders, flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:

1. Wall and Roof Sheathing:
 - a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
 - b. Space panels 1/8 inch apart at edges and ends.
2. Subflooring:
 - a. Glue and nail to wood framing.
 - b. Screw to cold-formed metal framing.
 - c. Space panels 1/8 inch apart at edges and ends.
3. Underlayment:
 - a. Nail or staple to subflooring.
 - b. Space plywood panels 1/32 inch apart at edges and ends.
 - c. Space sound control panels 1/8 inch apart at edges and ends.

END OF SECTION

SECTION 064020

INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Interior standing and running trim. To match existing where indicated.
2. Interior frames and jambs.
3. Plastic-laminate casework.
4. Plastic-laminate countertops.
5. Closet and utility shelving.
6. Shop finishing of interior woodwork.

- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 061000 - ROUGH CARPENTRY for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
2. Section 064200 - PANELING for wood paneling.
3. Section 099000 - PAINTING AND COATING for field finishing work of this Section.

1.3 SUBMITTALS

- A. Product Data: For each type of product specified, including casework hardware and accessories, and finishing materials and processes.

1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
2. For fabric and padding, documentation indicating that the materials contain no chemical flame retardants.

- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - a. Provide schedule of blocking required to support the Work of this Section.

2. Show locations and sizes of cutouts and holes for plumbing fixtures, electrical components and other items installed in architectural woodwork.
3. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

C. Samples for Verification:

1. Lumber with or for transparent finish, not less than 5 inches wide by 12 inches long for each species and cut, finished on 1 side and 1 edge.
2. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.
 - a. Submit step-type range sample sets of factory finished plywood and factory finished solid wood in size illustrating wood grain and specified finish, including edge banding detail and any veneer or solid edge glue joints.
 - b. Submit one leaf for every 1000 gross square foot of veneer required.
3. 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, with 1/2 of exposed surface finished.
4. Plastic laminates, 8 by 10 inches for each type, color, pattern, and surface finish, with 1 sample applied to core material, and specified edge material applied to 1 edge.
5. Solid-surfacing materials, 6 inches square.

D. Qualification Data: For Installer and fabricator.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with blueprint-matched wood veneers and components.
- C. Quality Standard: Unless otherwise indicated, comply with AWI/AWMAC/WI's "Architectural Woodwork Standards," latest edition, including errata, for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
- D. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.
 1. Fire-Test-Response Characteristics of Upholstery Fabric and Padding: Comply with California Technical Bulletin 117-2013 Update, with no chemical flame retardants.

- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
 - 1. The HVAC systems as specified elsewhere may not provide for humidity controls. The expected ranges of relative humidity are expected to be as high as 55% to a low of uncontrolled during the heating system. Comply with AWS Section 2, Care and Storage.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 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.

PART 2 - PRODUCTS

2.1 BASIS-OF-DESIGN

- A. Basis-of-Design Products: Refer to the Finish Schedule on the Drawings.

2.2 MATERIALS

- A. General: Provide materials that comply with requirements of AWI/AWMAC/WI's "Architectural Woodwork Standards" for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Veneers and Lumber: Provide AWI Custom Grade materials and workmanship, unless otherwise indicated. For species not listed in the AWS comply with the following:
 - 1. Provide AWI Lumber Grade 1 and AWI Grade A Veneer, book-matched, minimum 6 inch face veneer width. Kiln dry to 6-8 percent moisture content. Components shall be free of defects and sapwood. Match adjacent pieces for color and grain pattern.
 - 2. Single-Source Requirement for Wood Veneers and Solids: Intent is to provide wood which matches as closely as possible throughout the project. Provide wood veneers and solids from the same distributor, and from the same flitches and solids sources to the greatest extent possible.
- C. Wood Species and Cut for Transparent Finish: As selected by the Architect.
 - 1. Architect's control samples for transparent finish, veneer grain and figure characteristics are available for review at the office of the Architect.
 - 2. Veneer Matching Requirements:
 - a. Matching Between Adjacent Veneer Leaves: Book match and architectural end match.
 - b. Matching Within Individual Panel Faces: Balance and Center Match.
 - c. Method of Matching Panels: Blueprint-matched panels and components.
- D. Wood Species for Opaque Finish: Any closed-grain hardwood.
- E. Composite Wood Products: Comply with the following:
 - 1. Composite Wood, General: CARB II compliant or made with binder containing no added formaldehyde (NAF).
 - 2. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade MD.
 - 3. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
 - 4. Softwood Plywood: DOC PS 1, Medium Density Overlay (MDO).
 - 5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.
 - a. Resin impregnated paper backs are not permitted. Backs shall be of compatible hardwood species and cut. Contact adhesive is not permitted.
- F. High-Pressure Decorative Plastic Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated into the Work include, but are not limited to, the following:
 - a. Abet Laminati, Inc.
 - b. Arborite; a division of Wilsonart.
 - c. Formica Corporation.

- d. Lamin-Art; a division of Wilsonart.
- e. Nevamar, Panolam, and Pionite; divisions of Panolam Surface Systems.
- f. Wilsonart LLC.

- G. Tempered Float Glass for Casework: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3, with exposed edges seamed before tempering, 1/4 inch (6 mm) thick, unless otherwise indicated.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- 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.
 - 1. Do not use treated materials that do not comply with requirements of referenced woodworking standard or 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 UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Comply with performance requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Use the following treatment type:
 - 1. Exterior Type: Organic-resin-based formulation thermally set in wood by kiln drying.
 - 2. Mill lumber before treatment and implement special 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.
 - 3. Kiln-dry materials before and after treatment to levels required for untreated materials.
- C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.
 - 1. Fire-Retardant Fiberboard and Particleboard: Provide five ply construction with crossbands to prevent any ammonia fuming from the core to the face veneers.

2.4 CASEWORK HARDWARE AND ACCESSORIES

- A. General: Provide casework hardware and accessory materials associated with architectural casework, except for items specified in Section 087100 - DOOR HARDWARE.
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 100 degrees of opening, self-closing.
- C. Back-Mounted Pulls: BHMA A156.9, B02011.

- D. Catches: Push-in magnetic catches, BHMA A156.9, B03131.
- E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081 or BHMA A156.9, B04102; with shelf brackets, B04112.
- F. Drawer Slides: BHMA A156.9, B05091; side mounted and extending under bottom edge of drawer; full-extension type; epoxy-coated-steel with steel ball-bearings; of the following grades:
 - 1. Box Drawer Slides: Grade 1.
 - 2. File Drawer Slides: Grade 1HD-100.
 - 3. Pencil Drawer Slides: Grade 2.
 - 4. Keyboard Slides: Grade 1.
 - 5. Trash Bin Slides: Grade 1HD-100.
- G. Aluminum Slides for Sliding Glass Doors: BHMA A156.9, B07063.
- H. Door Locks: BHMA A156.11, E07121.
- I. Drawer Locks: BHMA A156.11, E07041.
- J. Grommets for Cable Passage through Countertops: Molded-plastic grommets and matching plastic caps with slot for wire passage.
- K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Satin Stainless Steel: BHMA 630.
 - 2. Satin Aluminum, Clear Anodized: BHMA 628.
- L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.5 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- C. Installation Adhesives and Wood Glues: Formulations approved for use indicated by adhesive manufacturer.
 - 1. Low-Emitting Materials: Provide adhesives in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - 2. VOC Limits: Use installation adhesives that comply with the following limits for VOC content:

- a. Wood Glues: 30 g/L.
 - b. Contact Adhesives: Not permitted on the Project without Architect's prior approval.
3. Do not use adhesives that contain urea formaldehyde.
 4. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.

2.6 FABRICATION, GENERAL

- A. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- B. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 1. Corners of Casework and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch.
- D. 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.
- E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 1. Seal edges of openings in countertops with a coat of varnish.
- F. Install glass to comply with applicable requirements in Section 088000 - GLAZING and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

2.7 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Grade: Custom.
- B. Wood Species and Cut: As specified hereinabove.
 1. Provide split species on trim that faces areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.
- C. For trim items wider than available lumber, use veneered construction. Do not glue for width.
- D. For rails wider or thicker than available lumber, use veneered construction. Do not glue for width or thickness.
- E. Assemble casings in plant except where limitations of access to place of installation require field assembly.

2.8 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

- A. Grade: Custom.
- B. Wood Species: Any closed-grain hardwood.
- C. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
- D. Assemble casings in plant except where limitations of access to place of installation require field assembly.

2.9 PLASTIC-LAMINATE CASEWORK

- A. Grade: Custom.
- B. AWI Type of Casework Construction: Flush overlay.
- C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 - 1. Horizontal Surfaces Other Than Tops: Grade HGS.
 - 2. Postformed Surfaces: Grade HGP.
 - 3. Vertical Surfaces: Grade HGS.
 - 4. Edges: Grade HGS.
- D. Materials for Semiexposed Surfaces:
 - 1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.
 - a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch minimum thickness, matching laminate in color, pattern, and finish.
 - b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade VGS.
 - 2. Drawer Sides and Backs: Solid-hardwood lumber.
 - 3. Drawer Bottoms: Hardwood plywood.
- E. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.
- F. 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 selected by Architect from laminate manufacturer's full range.

2.10 PLASTIC-LAMINATE COUNTERTOPS

- A. Grade: Custom.
- B. High-Pressure Decorative Laminate Grade: HGS.

- C. 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 selected by Architect from manufacturer's full range.
- D. Edge Treatment: As indicated.
- E. Core Material: Exterior-grade plywood.
- F. Backer Sheet: Provide plastic-laminate backer sheet, Grade BKL, on underside of countertop substrate.
- G. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

2.11 CLOSET AND UTILITY SHELVING

- A. Grade: Custom.
- B. Shelf Material: Field painted 1/2 inch plywood panel product with solid-lumber edge on exposed front and ends.
- 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.

2.12 SHOP FINISHING

- A. General: Comply with AWI/AWMAC/WI's "Architectural Woodwork Standards" for factory finishing.
 - 1. Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
 - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.
- C. Shop Priming: Shop apply the prime coat including backpriming, if any, for opaque-finished items specified to be field finished. Refer to Section 099000 - PAINTING AND COATING for material and application requirements.
- D. Transparent Finish: Comply with requirements indicated below for grade, finish system, staining, and sheen with sheen measured on 60-degree gloss meter per ASTM D 523:
 - 1. Grade: Same as item to be finished.
 - 2. AWS Finish System 5: Conversion varnish.

3. Washcoat for Closed-Grain Woods: Apply washcoat sealer to woodwork made from closed-grain wood before staining and finishing
 4. Staining: Match approved sample for color.
 5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
 6. Sheen: Satin, 30-50 gloss units.
 7. Effect: Partially filled pore.
- E. Opaque Finish: Comply with requirements indicated below for grade, finish system, color, effect, and sheen, with sheen measured on 60-degree gloss meter per ASTM D 523.
1. Grade: Same as item to be finished.
 2. AWS Finish System 5: Conversion varnish.
 3. Color: As selected by Architect from manufacturer's full range.
 4. Sheen: Satin, 30-50 gloss units.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- F. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- G. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use

pieces less than 60 inches long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.

1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.
 2. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.
- H. Casework: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
1. Install casework with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 2. Maintain veneer sequence matching of casework with transparent finish.
 3. Attach casework to walls with mechanical fasteners. Do not use adhesives, so that casework may be removed and salvaged in the future.
- I. Countertops: Anchor securely by screwing through corner blocks of base casework or other supports into underside of countertop.
1. Align adjacent countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 3. Secure backsplashes to tops with concealed metal brackets at 16 inches and to walls with adhesive.
 4. Calk space between backsplash and wall with sealant specified in Section 079200 - JOINT SEALANTS.
- J. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

SECTION 064200

PANELING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Board paneling.
 - 2. Shop finishing work of paneling.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 061000 - ROUGH CARPENTRY for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
 - 2. Section 064020 - INTERIOR ARCHITECTURAL WOODWORK for trim at wood paneling.

1.3 DEFINITIONS

- A. Paneling includes wood furring, blocking, and shims for installing paneling, unless concealed within other construction before paneling installation.

1.4 SUBMITTALS

- A. Product Data: For each type of product specified, including cabinet hardware and accessories, and finishing materials and processes.
 - 1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. Shop Drawings: Show location of paneling, large-scale details, attachment devices, and other components. Include dimensioned plans and elevations.
 - 1. Show details full size.
 - 2. Show locations and sizes of furring and blocking, including concealed blocking specified in other Sections.
 - 3. For paneling produced from premanufactured sets, show finished panel sizes, set numbers, sequence numbers within sets, and method of cutting panels to produce indicated sizes.

4. For paneling veneered in fabrication shop, show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

C. Samples for Initial Selection:

1. Shop-applied transparent finishes.

D. Samples for Verification:

1. Lumber with or for transparent finish, not less than 5 inches wide by 12 inches long, for each species and cut, finished on 1 side and 1 edge.
2. Veneer leaves representative of and selected from flitches to be used for transparent-finished paneling.
3. Veneer-faced panel products with or for transparent finish, 12 by 24 inches, for each species and cut. Include at least one face-veneer seam and finish as specified.

E. Qualification Data: For Installer and fabricator.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

- B. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood veneers.

- C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

- D. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.

- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver paneling until painting and similar operations that could damage paneling have been completed in installation areas. If paneling must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install paneling until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where paneling is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support paneling by field measurements before being enclosed and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating paneling without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that paneling can be installed as indicated.

PART 2 - PRODUCTS

2.1 BASIS-OF-DESIGN

- A. Basis-of-Design Products: Refer to the Finish Schedule on the Drawings.

2.2 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for quality grade specified, unless otherwise indicated.
- B. Wood Lumber: Provide AWI Custom Grade materials and workmanship, unless otherwise indicated. For species not listed in the AWS comply with the following:
 - 1. Single-Source Requirement for Wood Solids: Intent is to provide wood which matches as closely as possible throughout the project. Provide wood solids from the same distributor, and from the same solids sources to the greatest extent possible.
- C. Wood Species and Cut for Product Remian Unfinish: As selected by the Architect.

1. Architect's control samples for transparent finish, veneer grain and figure characteristics are available for review at the office of the Architect.
- D. Installation Adhesives and Wood Glues: Formulations approved for use indicated by adhesive manufacturer.
1. Low-Emitting Materials: Provide adhesives in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 2. VOC Content: Use installation adhesives that comply with the following limits:
 - a. Wood Glues: 30 g/L.
 - b. Contact Adhesives: Not permitted on the Project without Architect's prior approval.
 3. Do not use adhesives that contain urea formaldehyde.
 4. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.

2.3 INSTALLATION MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- B. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.
- C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.4 FABRICATION, GENERAL

- A. Paneling Grade: Provide Custom grade paneling complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- D. Arrange paneling in shop or other suitable space in proposed sequence for examination by Architect. Mark units with temporary sequence numbers to indicate position in proposed layout.
 1. Lay out one elevation at a time if approved by Architect.
 2. Notify Architect seven days in advance of the date and time when layout will be available for viewing.
 3. Provide lighting of similar type and level as that of final installation for viewing layout, unless otherwise approved by Architect.
 4. Rearrange paneling as directed by Architect until layout is approved.

5. Do not trim end units and other nonmodular size units to less than modular size until after Architect's approval of layout. Indicate trimming by masking edges of units with nonmarking material.
 6. Obtain Architect's approval of layout before start of assembly. Mark units and Shop Drawings with assembly sequence numbers based on approved layout.
- E. Complete fabrication, including assembly and finishing, 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 the dates and times paneling fabrication will be complete.
 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.
- F. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

2.5 BOARD PANELING FOR UNFINISH APPEARANCE

- A. Grade: Custom.
- B. Wood Species and Cut: As indicated on the Finish Schedule.
- C. Pattern: As indicated.
- D. Shop fabricate board paneling from boards of standard random lengths, complying with applicable grading rules. Machine edges and ends of boards to provide joint profiles indicated.
- E. Preassemble board paneling into largest units that can be delivered into installation areas using permanent or temporary backing members as indicated. To maximum extent possible, fabricate units in sizes determined by field measurements of existing conditions and that will avoid fitting in the field; make provision for separate scribing pieces to be fitted to adjoining finished surfaces. Provide shop-prepared detachable pieces for forming joints with other units at Project site and with other types of architectural woodwork.

2.6 TONGUE AND GROOVE (T&G) BOARD PANELING FOR PAINT FINISH

- A. Grade: Custom.
- B. Wood Species and Cut: As indicated on the Finish Schedule.
- C. Pattern: As indicated.
- D. Shop fabricate t&g board paneling in lengths to provide pieces that are uninterrupted by joints. Machine edges of boards to provide joint profiles indicated.

- E. Preassemble board paneling into largest units that can be delivered into installation areas using permanent or temporary backing members as indicated. To maximum extent possible, fabricate units in sizes determined by field measurements of existing conditions and that will avoid fitting in the field; make provision for separate scribing pieces to be fitted to adjoining finished surfaces. Provide shop-prepared detachable pieces for forming joints with other units at Project site and with other types of architectural woodwork.

2.7 SHOP FINISHING

- A. General: Comply with AWI/AWMAC/WI's "Architectural Woodwork Standards" for factory finishing.
 - 1. Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
- C. Shop Priming: Shop apply the prime coat including backpriming, if any, for opaque-finished items specified to be field finished. Refer to Section 099000 - PAINTING AND COATING for material and application requirements.
- D. Opaque Finish: Comply with requirements indicated below for grade, finish system, color, effect, and sheen, with sheen measured on 60-degree gloss meter per ASTM D 523.
 - 1. Grade: Same as item to be finished.
 - 2. AWS Finish System 5: Conversion varnish.
 - 3. Color: As selected by Architect from manufacturer's full range.
 - 4. Sheen: Satin, 30-50 gloss units.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition paneling to average prevailing humidity conditions in installation areas.
- B. Before installing paneling, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Grade: Install paneling to comply with requirements for same grade specified in Part 2 for fabrication of type of paneling involved.
- B. Install paneling level, plumb, true, and straight with no distortions. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches. Install with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.

1. For flush paneling with revealed joints, install with variations in reveal width, alignment of top and bottom edges, and flushness between adjacent panels not exceeding 1/32 inch.
 - C. Scribe and cut paneling to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 - D. Anchor paneling to supporting substrate with concealed panel-hanger clips. Do not use face fastening unless covered by trim.
 - E. Complete finishing work specified in this Section to extent not completed at shop or before installation of paneling. Fill nail holes with matching filler where exposed. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are applied in shop.
- 3.3 ADJUSTING AND CLEANING
- A. Repair damaged and defective paneling, where possible, to eliminate functional and visual defects; where not possible to repair, replace paneling. Adjust for uniform appearance.
 - B. Clean paneling on exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

SECTION 070150

MODIFICATIONS TO EXISTING ROOFING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Modify existing roofing systems as required to accommodate new construction or equipment removal.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 061000 - ROUGH CARPENTRY for wood nailers, curbs, and blocking.
 - 2. Section 079200 - JOINT SEALANTS for sealants.
 - 3. Division 22 - PLUMBING for roof drains.
 - 4. Division 23 - HEATING, VENTILATING, AND AIR CONDITIONING for roof curbs for HVAC equipment.

1.3 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- C. Roofing System Design: Roofing system shall be designed to withstand Code required loads and wind speeds.
- D. Flashings: Provide base flashings, perimeter flashings, detail flashings and component materials that comply with requirements and recommendations in FMG 1-49 Loss Prevention Data Sheet for Perimeter Flashings; FMG 1-29 Loss Prevention Data Sheet for Above Deck Roof Components; NRCA Roofing and Waterproofing Manual (Fourth Edition) for Construction

Details and SMACNA Architectural Sheet Metal Manual (Fifth Edition) for Construction Details, as applicable.

- E. Certification: Upon completion of work of this Section, submit certification by existing roof manufacturer acknowledging that all work performed is acceptable and that the entire roof remains under warranty.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other Work.
 - 1. Base flashings and membrane terminations.
 - 2. Tapered insulation, including slopes.
 - 3. Insulation attachment patterns.
- C. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.
- D. Qualification Data: For Installer and manufacturer.
- E. Maintenance Data: For roofing system to include in maintenance manuals.
- F. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain components for roofing system from or approved by roofing system manufacturer.
- B. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 01. Review methods and procedures related to roofing system including, but not limited to, the following:
 - 1. Meet with the Architect, Owner, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - 3. 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 will affect 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.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

- A. Roofing Contractor's Warranty: The roofing subcontractor shall supply Owner with a minimum two-year workmanship warranty for each roof. In the event any work related to the roofing, flashing, or metalwork is found to be defective within two years of substantial completion, the roofing contractor shall remove and replace such at no additional cost to the Owner. A copy of the roofing signed warranty shall be sent to the roofing system's manufacturer.
 1. The duration of the Roofing Contractor's two-year warranty shall run concurrent with the roofing system's manufacturer's existing warranty.
- B. Roofing Systems Manufacturer's Warranty: Maintain existing warranties. Coordinate with Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Compatibility: Provide products recommended by manufacturers to be fully compatible with indicated substrates. Provide separation materials as required to eliminate contact between incompatible materials.
 1. Furnish specific product acceptable to manufacturer of roofing membrane which will not compromise the roofing manufacturer's warranty.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 - 1. Verify that roof openings and penetrations are in place and set and braced and that roof drains 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 existing wood roof deck is sound and securely attached to structure.
 - 4. 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 installation according to 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.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- D. Coordinate installing membrane roofing system components so underlayment, vapor retarder, insulation, and cover boards are not exposed to precipitation or left exposed at the end of the workday.

3.3 INSTALLATION

- A. General: Install roofing system and components in accordance with manufacturer's recommendations, approved submittals, and in proper relationship with adjacent construction.
- B. General: Install roofing system and components in compliance with the following Sections:
 - 1. Section 073113 - ASPHALT SHINGLES.
 - 2. Section 075400 - THERMOPLASTIC MEMBRANE ROOFING.
- C. Comply with field quality control requirements for each Section.

END OF SECTION

SECTION 078410

PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.
- B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
 - 1. Section 078440 - FIRE-RESISTIVE JOINT SYSTEMS for fire-resistive joint sealers.
 - 2. Section 079200 - JOINT SEALANTS for standard joint sealers.
 - 3. Division 22 - PLUMBING for cutting penetrations for plumbing piping and providing firestopping complying with requirements in this Section.
 - 4. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING for cutting penetrations for ductwork and HVAC piping and providing firestopping complying with requirements in this Section.
 - 5. Division 26 - ELECTRICAL for cutting penetrations for cable and conduit and providing firestopping complying with requirements in this Section.
 - 6. Division 27 - COMMUNICATIONS for cutting penetrations for cable and conduit and providing firestopping complying with requirements in this Section.
 - 7. Division 28 - ELECTRONIC SAFETY AND SECURITY for cutting penetrations for cable and conduit and providing firestopping complying with requirements in this Section.

1.3 COORDINATION

- A. Jobsite conditions of each through-penetration firestop system must meet all details of the UL-Classified System selected. If jobsite conditions do not match any UL-classified systems, contact firestop manufacturer for alternative systems or Engineer Judgment Drawings.
- B. Coordinate work with other trades to assure that penetration-opening sizes are appropriate for penetrant locations.
- C. Verify that the schedule is current at the time of construction, and that each referenced system is suitable for the intended application.

1.4 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 - 1. Fire-resistance-rated walls include fire walls, fire-barrier walls, smoke-barrier walls and fire partitions.
 - 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 - 1. Horizontal assemblies include floors, floor/ceiling assemblies and ceiling membranes of roof/ceiling assemblies.
 - 2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
 - 3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
- D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
 - 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at 0.30-inch wg (74.7 Pa) at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping:
 - 1. Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
 - 2. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
 - a. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems demonstrating no evidence of water leakage when tested according to UL 1479.
 - b. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
- F. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.
 - 1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
- C. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:
 - 1. Types of penetrating items.
 - 2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
 - 3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.
- D. Qualification Data: For Installer.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Either a firm that has been approved by FMG according to FMG 4991, "Approval of Firestop Contractors" or a firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction of a minimum of five projects with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements.
- B. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.
- C. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.
- D. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
 - 1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
 - 2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems complying with the following requirements:
 - a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.

- b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed in the UL "Fire Resistance Directory."

- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- C. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, through-penetration firestop systems that may be incorporated into the Work include, but are not limited to the following:
 - 1. Hilti, Inc.
 - 2. Metacaulk; RectorSeal Corporation.
 - 3. Specified Technologies, Inc. (STI).
 - 4. 3M; Fire Protection Products Division.

2.2 FIRESTOPPING MATERIALS

- A. Low-Emitting Materials: Penetration firestopping sealants and sealant primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content:
 - 1. Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
 - 4. Methylene chloride and perchloroethylene may not be intentionally added to sealants.
- C. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- D. Materials: Provide through-penetration firestop systems containing primary materials and fill materials which are part of the tested assemblies indicated in the approved Through-Penetration Firestop System Schedule submittal. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.
 - 1. Available Products:
 - a. BioFireShield; RectorSeal Smoke and Acoustic Sealant.
 - b. Hilti; CP 606 Flexible Firestop Sealant.
 - c. Hilti; CP 653 BA Firestop Speed Sleeve.
 - d. Hilti; FS-ONE Intumescent Firestop Sealant.
- E. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated.
- F. Endothermic Mats: 3M Interam Endothermic Mats by 3M Fire Protection Products; located in rated walls behind cabinet unit heaters, fire extinguisher cabinets and electrical panels where there are space limitations to maintain the wall rating.

2.3 MIXING

- A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
- C. Install fill materials for firestop systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports, as required by 2015 IBC 1705.17 and 1705.17.1. Independent inspecting agency shall comply with ASTM E 2174 requirements including those related to qualifications, conducting inspections, and preparing test reports
- B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.
- C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

3.5 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

END OF SECTION

SECTION 078440

FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the Work of this Section, including but not limited to fire-resistive joint systems for the following:
 - 1. Floor-to-floor joints.
 - 2. Floor-to-wall joints.
 - 3. Head-of-wall joints.
 - 4. Wall-to-wall joints.
 - 5. Perimeter fire-resistive joint systems consisting of floor-to-wall joints between perimeter edge of fire-resistance-rated floor assemblies and exterior curtain walls.
- B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
 - 1. Section 078410 - PENETRATION FIRESTOPPING for firestopping.
 - 2. Division 21 - FIRE SUPPRESSION for fire-protection piping penetrations.
 - 3. Division 22 - PLUMBING for piping penetrations.
 - 4. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING for duct and piping penetrations.
 - 5. Division 26 - ELECTRICAL for cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which fire-resistive joint systems are installed.
- B. For fire-resistive systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each fire-resistive joint system, show each kind of construction condition in which joints are installed; also show relationships to adjoining construction. Include fire-

resistive joint system design designation of testing and inspecting agency acceptable to authorities having jurisdiction that demonstrates compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each fire-resistive joint system configuration for construction and penetrating items.
- C. Fire-Resistive Joint Systems Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.
1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- D. Product Certificates: For each type of fire-resistive joint system, signed by product manufacturer.
- E. Qualification Data: For Installer.
- F. Field quality-control test reports.
- G. Research/Evaluation Reports: For each type of fire-resistive joint system.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing through-penetration fire stop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction of a minimum of five projects with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Evidence of FMG 4991 approval is acceptable for installer qualifications, but not mandatory.
- B. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.
- C. Source Limitations: Obtain fire-resistive joint systems, for each kind of joint and construction condition indicated, through one source from a single manufacturer.
- D. Fire-Test-Response Characteristics: Provide fire-resistive joint systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
1. Fire-resistance tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for fire-resistive joint systems acceptable to authorities having jurisdiction.
 2. Fire-resistive joint systems are identical to those tested per methods indicated in Part 1 "Performance Requirements" Article and comply with the following:
 - a. Fire-resistive joint system products bear classification marking of qualified testing and inspecting agency.

- b. Fire-resistive joint systems correspond to those indicated by referencing system designations of the qualified testing and inspecting agency.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fire-resistive joint system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials for fire-resistive joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate fire-resistive joint systems per manufacturer's written instructions by natural means or, if this is inadequate, forced-air circulation.

1.8 COORDINATION

- A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.
- B. Coordinate sizing of joints to accommodate fire-resistive joint systems.
- C. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, fire-resistive joint systems that may be incorporated into the Work include, but are not limited to the following:
 - 1. Hilti, Inc.
 - 2. Metacaulk; RectorSeal Corporation.
 - 3. Specified Technologies, Inc. (STI).
 - 4. 3M; Fire Protection Products Division.

2.2 FIRE-RESISTIVE JOINT SYSTEMS

- A. Low-Emitting Materials: Fire-resistive joint system sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the

Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- B. VOC Content: Provide fire-resistive joint system sealants that comply with the following limits for VOC content:
 - 1. Architectural Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
 - 4. Methylene chloride and perchloroethylene may not be intentionally added to sealants.
- C. General: Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- D. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079.
- E. Joints at Exterior Curtain-Wall/Floor Intersections: Provide fire-resistive joint systems with rating determined by ASTM E 119 based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa) or ASTM E 2307.
 - 1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
- F. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079.
 - 1. L-Rating: Not exceeding 5.0 cfm/ft (0.00775 cu. m/s x m) of joint at 0.30 inch wg (74.7 Pa) at both ambient and elevated temperatures.
- G. Compatibility: Provide fire-resistive joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistive joint system manufacturer based on testing and field experience.
- H. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing and inspecting agency for systems 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 work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from fire-resistive joint system materials. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates or damaging adjoining surfaces.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with Part 1 "Performance Requirements" Article and fire-resistive joint system manufacturer's written installation instructions for products and applications indicated.
- B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
- C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply fill materials so they contact and adhere to substrates formed by joints.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports, as required by 2015 IBC 1705.17 and 1705.17.2. Independent inspecting agency shall comply with ASTM E 2393 requirements including those related to qualifications, conducting inspections, and preparing test reports.
- B. Testing Services: Inspecting of completed installations of fire-resistive joint systems shall take place in successive stages as installation of fire-resistive joint systems proceeds. Do not

proceed with installation of joint systems for the next area until inspecting agency determines completed work shows compliance with requirements.

1. Inspecting agency shall state in each report whether inspected fire-resistive joint systems comply with or deviate from requirements.
- C. Remove and replace fire-resistive joint systems where inspections indicate that they do not comply with specified requirements.
- D. Additional inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- E. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and fire-resistive joint systems comply with requirements.

3.5 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint 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 fire-resistive joint 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 fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION

SECTION 079200

JOINT SEALANTS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Joint sealants and fillers.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 042000 - UNIT MASONRY for masonry control and expansion joint fillers and gaskets.
 - 2. Section 088000 - GLAZING for glazing sealants.
 - 3. Section 092110 - GYPSUM BOARD ASSEMBLIES for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
 - 4. Section 093000 - TILING for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
 - 5. Section 095100 - ACOUSTICAL CEILINGS for sealing edge moldings at perimeters of acoustical ceilings.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

- A. Product Data: For each product indicated.
- B. 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.
- C. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

D. Qualification Data: For Installer and qualified testing agency.

E. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

F. Preconstruction Field Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in "Quality Assurance" Article.

G. Compatibility and Adhesion Test Reports: 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 needed for adhesion.

H. Field Test Report Log: For each elastomeric sealant application.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.

B. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

C. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

D. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - a. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - b. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with joint sealant backing and glazing and gasket materials.
2. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
3. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

4. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.
- E. Preconstruction Field-Adhesion Testing: Before installing elastomeric 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 application indicated below:
 - a. Each type of elastomeric sealant and joint substrate indicated.
 - b. Each type of nonelastomeric sealant and joint substrate indicated.
 3. Notify Architect seven days in advance of dates and times when test joints will be erected.
 - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193.
 - 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.
 4. Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
 5. 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.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.6 PROJECT 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.

1.7 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Five 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 natural causes exceeding design specifications.
 3. Mechanical damage caused by individuals, tools, or other outside agents.
 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. Low-Emitting Materials: Interior sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. VOC Content: Provide interior sealants and sealant primers that comply with the following limits for VOC content:
 1. Architectural Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
 4. Methylene chloride and perchloroethylene may not be intentionally added to sealants.
- D. Colors of Exposed Joint Sealants: Provide colors as selected by the Architect from manufacturer's full range of standard and custom colors; maximum of five colors, three standard colors and two custom colors.

2.2 JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

- B. Stain-Test-Response Characteristics: Elastomeric sealants shall be nonstaining to porous substrates. Provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600 or ANSI/NSF Standard 51.
- D. Exterior Silicone Sealant, Single-Component Neutral-Curing Type:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 790.
 - b. GE Silicones; SilPruf LM SCS2700.
 - c. Pecora Corporation; 864.
 - d. Tremco Inc.; Spectrem 1.
 - 2. Extent of Use: Exterior joints in vertical and soffit surfaces.
- E. Exterior Urethane Sealant, Multicomponent Pourable (Self-Leveling) Type for Pedestrian Traffic: ASTM C 920, Type M, Grade P, Class 25, Use T, M, & O.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Meadows, W. R., Inc.; POURTHANE.
 - b. Pecora Corporation; Urexpan NR-200.
 - c. Sika; Sikaflex-2c SL.
 - d. Tremco Inc.; THC-901.
 - 2. Extent of Use: Exterior joints in horizontal surfaces.
- F. Interior Sanitary Silicone Sealant, Single-Component Mildew-Resistant, Acid-Curing (Acetoxy) Type: ASTM C 920, Type S, Grade NS, Class 25, Use NT, G, A, and O.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Bostik; Pure Silicone.
 - b. Dow Corning Corporation; 786 Mildew Resistant.
 - c. GE Silicones; Sanitary SCS1700.
 - d. Pecora; 898NST.
 - e. Sika; Sikasil GP.
 - f. Tremco; Tremsil 200.
 - 2. Extent of Use: Interior sanitary joints at toilet rooms, kitchens, and other wet areas.
- G. Interior Acrylic Latex Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Henkel Corp.; Loctite Polyseamseal Acrylic Caulk with Silicone.
 - b. Pecora Corporation; AC-20+.
 - c. Tremco Inc.; Tremflex 834.
2. Extent of Use: Interior non-moving joints.

2.3 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type B (bicellular material with a surface skin) or other type, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
 1. Available Products: Armacell Canada Inc.; ITP Standard Backer Rod; or approved equal.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.4 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants 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 joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include concrete, masonry, unglazed surfaces of ceramic tile, and exterior insulation and finish systems.
 3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following metal, glass, porcelain enamel, and glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
 - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
 - 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.
 - 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. 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.
 - 4. 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 percent elongations, sealant material, sealant configuration, and sealant dimensions.
 - 5. 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.

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

3.5 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 and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 080152

HISTORIC TREATMENT OF WOOD WINDOWS AND DOORS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Exterior wood window and door repair.
 - 2. Exterior wood trim repair.
 - 3. Reglazing, exterior windows and doors only.
 - 4. Exterior window and door hardware repair, refinishing, and replacement.
 - 5. New exterior wood window with leaded/stained glass, to match existing.
- B. Alternates: Refer to Drawings and Section 012300 - ALTERNATES for requirements.
- C. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Division 06 Section for repairs and restoration to existing wood carvings.
 - 2. Section 062010 - EXTERIOR FINISH CARPENTRY for exterior wood trim replacement.
 - 3. Division 08 Section for repairs and restoration to existing leaded/stained glass.
 - 4. Section 099000 - PAINTING AND COATING for field-applied paints.

1.3 DEFINITIONS

- A. Wood Window Component Terminology: As identified in AWI's "Architectural Woodwork Quality Standards." Wood window components for historic treatment work include the following classifications:
 - 1. Frame Components: Head, jamb, and sill.
 - 2. Sash Components: Stile and rails, parting bead, stop, and muntins.
 - 3. Exterior Trim: Exterior casing, brick mould, and drip cap.
 - 4. Interior Trim: Casing, stool, and apron.
- B. Design Reference Sample: A Sample that represents Architect's prebid selection of work to be matched; it may be existing work or specially produced for Project.
- C. Glazing: Includes glass, glazing points, glazing tapes, glazing sealants, and glazing compounds.

- D. Window: Includes window frame, sash and glazing, unless otherwise indicated by the context.
- E. Door: Includes door panel, frame and glazing, unless otherwise indicated by the context.

1.4 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified historic treatment specialist to perform preconstruction testing on historic wood windows and doors.
 - 1. Test historic treatment methods for effectiveness and compliance with specified requirements.
 - 2. Notify Architect seven days in advance of the dates and times when testing will be performed.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include recommendations for application and use. Include test data substantiating that products comply with requirements.
- B. Shop Drawings: For repair and replacement of historic wood windows, doors, and components. Show location and extent of replacement work, with enlarged details of replacement parts indicating materials, profiles, joinery, reinforcing, method of splicing into or attaching to existing wood window, wood door, accessory items, and finishes. Include field-verified dimensions and the following:
 - 1. Templates and directions for installing hardware and anchorages.
 - 2. Component numbers and corresponding window locations in the building on annotated plans and elevations.
 - 3. Provisions for sealant joints as required for location.
 - 4. Locations and details for weatherstripping.
- C. Samples for Verification: For the following items of size indicated below, finished as required for use in the Work:
 - 1. Replacement Members: 12 inches long for each replacement member; including parts of frame, sash, and exterior trim.
 - a. Architect reserves the right to require additional Samples of replacement members that show fabrication techniques, materials, and finishes.
 - 2. Repaired and Refinished Wood Window and Door Members: Prepare Samples using existing wood window members removed from site, repaired, and refinished.
 - 3. Hardware: Full-size units with factory-applied finishes.
 - 4. Weather Stripping: 12-inch long sections.
- D. Qualification Data: For qualified historic treatment specialist.
- E. Historic Treatment Program: Submit before work begins.
- F. Preconstruction Test Reports: For historic treatment of wood windows and doors.

1.6 QUALITY ASSURANCE

- A. Performance Requirements: Comply with recommendation of National Park Service Preservation Briefs, including, but not limited to, the following:
 - 1. 09: The Repair of Historic Wooden Windows
- B. Historic Treatment Specialist Qualifications: Engage an experienced, wood window, door and trim restoration firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance.
 - 1. Field Supervision: Restoration specialist firms shall maintain experienced full-time supervisors on Project site during times that wood window, door and trim restorations are in progress. Supervisors shall not be changed during Project except for causes beyond the control of restoration specialist firm.
 - 2. Restoration Worker Qualifications: Persons who are experienced and specialize in restoration work of types they will be performing.
- C. Historic Treatment Program: Prepare a written plan for historic treatment of wood windows and doors, including each phase or process, protection of surrounding materials during operations, and control of spills during on-site repair and other processes. Describe, in detail, materials, methods, and equipment to be used for each phase of work. Show compliance with indicated methods and procedures related to historic treatment of wood windows specified in this and other Sections.
- D. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for materials and execution and for fabrication and installation. Prepare mockups so they are inconspicuous or reversible.
 - 1. Locate mockups either on the building where directed by Architect or in locations that enable viewing under same conditions as the completed Work, as approved by Architect.
 - 2. Wood Window Repair: Prepare one entire window unit to serve as mockup to demonstrate sample repairs of wood window members including frame, sash, glazing, and hardware.
 - 3. Wood Door Repair: Prepare one entire door unit to serve as mockup to demonstrate sample repairs of wood door members including door panel, frame, glazing, and hardware.
 - 4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. AWI Quality Standard: Comply with applicable requirements in AWI's "Architectural Woodwork Quality Standards" for construction, finishes, grades of wood windows, and other requirements.
- F. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to historic treatment of wood windows and doors including, but not limited to, the following:

- a. Construction Schedule: Verify availability of materials, personnel, equipment, and facilities needed to make progress and avoid delays.
- b. Materials, material application, sequencing, tolerances, and required clearances.
- c. Maintaining weathertight building enclosures during contract period.

1.7 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with historic treatment of wood windows and doors only when existing and forecasted weather conditions are within the environmental limits set by each manufacturer's written instructions and specified requirements.
- B. Concealed and undocumented historic items, relics, and similar objects encountered during historic treatment remain Owner's property. Carefully dismantle and salvage each item or object.
 1. Coordinate with Owner's archaeologist or historical adviser, who will establish special procedures for dismantling and salvaging.

1.8 SEQUENCING AND SCHEDULING

- A. Perform historic treatment of wood windows and doors in the following sequence:
 1. Stamp each window and door frame with permanent opening-identification number in inconspicuous location. Include stamping all window and door components, including sash weights, if removed.
 2. Tag existing window sash and door panels with opening-identification numbers and remove for on-site or off-site shop repair. Indicate on tags the locations on window of these components such as top sash and bottom sash.
 3. Allow installation of temporary protection, weathertight enclosures, and security at window openings according to Division 01 Sections.
 4. Remove window, remove door, dismantle hardware, and tag hardware with window and door opening-identification numbers.
 5. In the shop, stamp each sash, and door panel unit with permanent opening-identification number in inconspicuous location and remove site-applied tags.
 6. Sort units by condition, separating those that need extensive repair.
 7. Clean surfaces.
 8. General Wood-Repair Sequence:
 - a. Remove paint to bare wood according to Section 099000 - PAINTING AND COATING.
 - b. Rack frames slightly; inject adhesive into mortise and tenon joints.
 - c. If thicker than original glass is required, rout muntins to required rebate size.
 - d. Repair wood by consolidation, member replacement, partial member replacement, and patching.
 - e. Sanding:
 - 1) For exterior surfaces, prime, fill, sand again, and prime surfaces again for refinishing according to Section 099000 - PAINTING AND COATING.
 - 2) For interior surfaces, sand only.
 9. Repair, refinish, and replace hardware if required. Reinstall essential operating hardware. Use workers skilled in the trades involved to installing new hardware where scheduled and reinstall items that were removed.

10. Install glazing.
11. Allow removal of temporary protection, weathertight enclosures, and security at window openings according to Division 01 Sections.
12. Reinstall units.
13. Apply finish coats to exterior components according to Section 099000 - PAINTING AND COATING.
14. Install remaining hardware and weather stripping. Use workers skilled in the trades involved to installing new hardware where scheduled and reinstall items that were removed.

PART 2 - PRODUCTS

2.1 REPLACEMENT WOOD MATERIALS

- A. Wood: Clear fine-grained lumber; kiln dried to a moisture content of 6 to 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch deep by 2 inches wide.
 1. Species: Match species of each existing type of wood product, unless otherwise indicated.

2.2 WOOD REPAIR MATERIALS

- A. Wood Consolidant: Ready-to-use product designed to penetrate, consolidate, and strengthen soft fibers of wood materials that have deteriorated due to weathering and decay and designed specifically to enhance the bond of wood-patching compound to existing wood.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Abatron, Inc.; LiquidWood.
 - b. ConServ Epoxy LLC; Flexible Epoxy Consolidant 100.
 - c. Wood Care Systems; ROTFIX.
- B. Wood-Patching Compound: Two-part epoxy-resin wood-patching compound; knife-grade formulation as recommended by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be designed for filling voids in damaged wood materials that have deteriorated due to weathering and decay. Compound shall be capable of filling deep holes and spreading to feather edge.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Abatron, Inc.; LiquidWood with WoodEpoxy.
 - b. Advanced Repair Technology, Inc.; Primatrate with Flex-Tec HV.
 - c. ConServ Epoxy LLC; Flexible Epoxy Consolidant 100 with Flexible Epoxy Patch 200.
 - d. Polymeric Systems, Inc.; QuickWood.
 - e. West System Inc.; West System.
 - f. Wood Care Systems; ROTFIX with SCULPWOOD.

2.3 GLAZING MATERIALS

- A. Glass: Uncoated float-glass, ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
 - 1. Tempered Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; Kind FT.
 - 2. Restoration Glass: To match existing.
 - a. Available Manufacturer: Bendheim Restoration Glass.
 - 3. Glass Thickness: To match existing.
- B. Glazing Systems:
 - 1. Single Glass Units: Primer as recommended by glazing material manufacturer, with oil-based glazing putty or glazing compound and glazing points.
- C. Glazing Repair Materials, General: Provide materials and types of materials and miscellaneous items as required for making glazing repairs and reglazing old and historic windows with single glass (non-insulated) units.
- D. Glazing Putty: Oil-based glazing putty.
- E. Glazing Nails (or Points): Metal to match came, as required.
- F. Leaded/Stained Glass Materials: Provide for new leaded/stained glass panels:
 - 1. Metal Came: Lead, copper or zinc to match existing.
 - 2. Solder: ASMT B 32, grade for metal indicated.
 - 3. Flux and welding rods.
 - 4. Whiting: For cleaning leaded glass.
 - 5. Patina: Black or copper patina, to match existing.
 - 6. Finishing Compound: Wax finishing compound.

2.4 WINDOW HARDWARE

- A. General: Provide complete sets of window hardware consisting of sash balances, hinges, pulls, latches, and accessories indicated for each window or required for proper operation. Window hardware shall smoothly operate, tightly close, and securely lock wood windows and be sized to accommodate sash or ventilator weight and dimensions.
- B. Replacement Window Hardware: Replace existing damaged or missing window hardware with new hardware manufactured by one of the following:
 - 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. Ball and Ball.
 - b. Blaine Window Hardware Inc.
 - c. Bronze Craft Corporation (The).
 - d. Custom Trades International, Inc.
 - e. Parrett Manufacturing, Inc.

f. Phelps Company.

C. Material and Design:

1. Material: Solid bronze of alloy indicated.
2. Design: Match existing hardware.
3. Weight and Pulley Sash-Balance: Concealed weight and pulley balance system including steel or cast iron weights, cast-bronze pulleys, synthetic sash cord or sash chain; size and capacity to hold sash stationary at any open position.
4. Replacement Window Hardware: Match existing window hardware of the following types:
 - a. Projected window hinge.
 - b. Window lock.
 - c. Window latch.
 - d. Handle.

D. Window Hardware Finishes: Comply with BHMA A156.18 for base material and finish requirements indicated by the following:

1. BHMA 605: Bright brass, clear coated, brass base metal.
2. BHMA 606: Satin brass, clear coated, brass base metal.
3. BHMA 611: Bright bronze, clear coated, bronze base metal.
4. BHMA 612: Satin bronze, clear coated, bronze base metal.
5. BHMA 613: Dark-oxidized satin bronze, oil rubbed, bronze base metal.
6. BHMA 624: Dark-oxidized statuary bronze, clear coated, bronze base metal.

2.5 DOOR HARDWARE

- A. General: Repair existing door hardware consisting of hinges, locksets, closers, keyed cylinders, weather stripping, thresholds, and accessories indicated for each door or required for proper operation. Door hardware shall smoothly operate, tightly close, and securely lock doors.

2.6 REPLICATED WOOD WINDOWS

- A. Replicated Wood Windows: Custom-fabricated replacement wood windows and trim, with operating and latching hardware; fabricated according to AWI Section 1000 requirements for Premium Grade.
1. Joint Construction: Joints matching existing.
 2. Wood Species: Match wood species of exterior window trim and frame parts.
 3. Wood Window Members and Trim: Match profiles and detail of existing window members and trim.

2.7 WEATHER STRIPPING

- A. Compression-Type Weather Stripping: Compressible weather stripping designed for permanently resilient sealing under bumper or wiper action; completely concealed when window and door is closed.
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. National Guard Products, Inc.
 - b. Pemko Manufacturing Co., Inc.; an ASSA ABLOY company.
 - c. Reese Enterprises, Inc.
 - d. Zero International, Inc.
2. Weather-Stripping Material: Match existing materials and profiles as much as possible unless otherwise indicated.
 - a. Cellular Elastomeric Gaskets: Preformed; complying with ASTM C 509.
 - b. Dense Elastomeric Gaskets: Preformed; complying with ASTM C 864.
- B. Sliding-Type Weather Stripping: Woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric; complying with AAMA 701/702.
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. National Guard Products, Inc.
 - b. Pemko Manufacturing Co., Inc.; an ASSA ABLOY company.
 - c. Reese Enterprises, Inc.
 - d. Zero International, Inc.
 2. Weather Seals: Elastomeric preformed seal with integral barrier fin or fins of semirigid, polypropylene sheet or polypropylene-coated material.
- C. Metal Weather Stripping: Bronze weather stripping as indicated on Drawings; designed either as one piece to seal by sliding into a groove in the sash or as two pieces that interlock with each other; and completely concealed when wood window and door is closed.
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. Accurate Metal Weatherstrip Co. Inc.
 - b. Zero International, Inc.

2.8 MISCELLANEOUS MATERIALS

- A. Borate Preservative Treatment: Inorganic, borate-based solution, with disodium octaborate tetrahydrate as the primary ingredient; manufactured for preserving weathered and decayed wood from further damage by decay fungi and wood-boring insects; complying with AWPA P5; containing no boric acid.
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. Abatron, Inc.
 - b. Nisus Corporation.
 - c. Wood Care Systems.

- B. Cleaning Materials:
1. Detergent Solution: Solution prepared by mixing 2 cups of tetrasodium polyphosphate, 1/2 cup of laundry detergent that contains no ammonia, 5 quarts of 5 percent sodium hypochlorite bleach, and 15 quarts of warm water for each 5 gal. of solution required.
 2. Mildewcide: Provide commercial proprietary mildewcide or a solution prepared by mixing 1/3 cup of household detergent that contains no ammonia, 1 quart of 5 percent sodium hypochlorite bleach, and 3 quarts of warm water.
- C. Adhesives: Wood adhesives for exterior exposure, with minimum 15- to 45-minute cure at 70 deg F, in gunnable and liquid formulations as recommended by adhesive manufacturer for each type of repair.
- D. Fasteners: Fasteners of same basic metal as fastened metal unless otherwise indicated. Use metals that are noncorrosive and compatible with each material joined.
1. Match existing fasteners in material and type of fastener unless otherwise indicated.
 2. Use concealed fasteners for interconnecting wood components.
 3. Use concealed fasteners for attaching items to other work unless exposed fasteners are unavoidable or the existing fastening method is decorative.
 4. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated.
 5. Finish exposed fasteners to match finish of metal fastened unless otherwise indicated.
- E. Anchors, Clips, and Accessories: Fabricate anchors, clips, and window accessories of aluminum, nonmagnetic stainless steel, or hot-dip zinc-coated steel complying with requirements in ASTM B 633 for SC 3 (Severe) service condition.

2.9 WOOD WINDOW, DOOR AND TRIM FINISHES

- A. Unfinished Repaired and Replacement Windows, Doors and Trims: Provide exposed exterior and interior wood surfaces of replacement windows unfinished; smooth, filled, and suitably prepared for on-site priming and finishing.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect adjacent materials from damage by historic treatment of wood windows, doors and trims.
- B. Clean existing wood windows, doors and trims of mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. After cleaning, rinse thoroughly with fresh water. Allow to dry before repairing or painting.
- C. Condition replacement wood members and replacement windows, doors and trims to prevailing conditions at installation areas before installing.

3.2 HISTORIC TREATMENT PROCEDURES, GENERAL

- A. General: Have historic treatment of wood windows, doors and trims directed and performed by a qualified historic treatment specialist. Ensure that historic treatment specialist's field supervisors are present when historic treatment of wood windows, doors and trims begins and during its progress. In treating historic items, disturb them as minimally as possible and as follows:
1. Follow the historic treatment sequence in "Sequencing and Scheduling" Article.
 2. Apply each product according to manufacturer's written instructions unless otherwise indicated.
 3. Stabilize and repair wood windows, doors and trims to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
 4. Stop the progress of deterioration by removing coatings and applying borate preservative treatment before repair.
 5. Repair items in place where possible and retain as much original material as possible.
 6. Replace or reproduce historic items where indicated or scheduled.
 7. Make historic treatment of materials reversible whenever possible.
 8. Install temporary protective measures to protect wood window, door and trim work that is indicated to be completed later.
- B. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use only the gentlest mechanical methods, such as scraping and natural-fiber bristle brushing, that will not abrade wood substrate, reducing clarity of detail. Do not use abrasive methods such as sanding, wire brushing, or power tools except as indicated as part of the historic treatment program and as approved by Architect.
- C. Repair and Refinish Existing Hardware: Dismantle window and door hardware; repair and refinish it to match finish samples.
- D. Repair Wood Windows, Doors and Trims: Match existing materials and features, retaining as much original material as possible to perform repairs.
1. Unless otherwise indicated, repair wood windows, doors and trims by consolidating, patching, splicing, or otherwise reinforcing wood with new wood matching existing wood or with salvaged, sound, original wood.
 2. Where indicated, repair wood windows, doors and trims by limited replacement matching existing material.
- E. Protection of Openings: Where sash or windows or doors are indicated for removal, cover resultant openings with temporary enclosures so that openings are weathertight during repair period.
1. Do not damage existing window frames or surrounding construction when installing temporary window closures. Temporary closures shall not obstruct restoration work scheduled for wood frames.
- F. Identify removed windows, sash, doors, and members with numbering system corresponding to window locations to ensure reinstallation in same location. Key windows, sash, doors, and members to Drawings showing location of each removed unit. Permanently stamp units in a location that will be concealed after reinstallation.

3.3 GLAZING

- A. Remove cracked and damaged glass and glazing materials from openings and prepare surfaces for reglazing.
- B. Install new glass and reinstall existing repaired glass with indicated glazing system.
- C. Disposal of Removed Glass: Remove from Owner's property and legally dispose of it, unless indicated to be reinstalled. Comply with requirements of Section 017400 - CONSTRUCTION WASTE MANAGEMENT.

3.4 WOOD WINDOW, DOOR AND TRIM PATCH-TYPE REPAIR

- A. General: Patch wood members that are damaged and exhibit depressions, holes, or similar voids, and that have limited rotted or decayed wood.
 - 1. Remove sash from windows before performing patch-type repairs at meeting or sliding surfaces unless otherwise indicated. Reglaze units prior to reinstallation.
 - 2. Remove doors from frames before performing patch-type repairs unless otherwise indicated. Reglaze units prior to reinstallation.
 - 3. Verify that surfaces are sufficiently clean and free of paint residue prior to patching.
 - 4. Treat wood members with wood consolidant prior to application of patching compound. Coat wood surfaces by brushing, applying multiple coats until wood is saturated and refuses to absorb more. Allow treatment to harden before filling void with patching compound.
- B. Apply borate preservative treatment to accessible surfaces either before applying wood consolidant or after removing rotted or decayed wood. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.
- C. Apply wood-patching compound to fill depressions, nicks, cracks, and other voids created by removed or missing wood.
 - 1. Prime patch area with application of wood consolidant or manufacturer's recommended primer.
 - 2. Mix only as much patching compound as can be applied according to manufacturer's written instructions.
 - 3. Apply patching compound in layers as recommended by manufacturer until the void is completely filled.
 - 4. Finish patch surface to match contour of adjacent wood member. Sand patching compound smooth and flush, matching contour of existing wood member.
 - 5. Clean spilled compound from adjacent materials immediately.

3.5 WOOD WINDOW MEMBER-REPLACEMENT REPAIR

- A. General: Replace parts of or entire wood window members at locations indicated on Drawings.
 - 1. Remove sash from windows before performing member-replacement repairs unless otherwise indicated.
 - 2. Verify that surfaces are sufficiently clean and free of paint residue prior to repair.
 - 3. Remove broken, rotted, and decayed wood down to sound wood.

4. Custom fabricate new wood to replace missing wood; either replace entire wood member or splice new wood part into existing member. Fabricate replacement members according to AWI Section 1000 WI Section 7 requirements for Premium Grade.
 5. Secure new wood using finger joints or multiple dowels with adhesive and nailing to ensure maximum structural integrity at each splice. Use only concealed fasteners. Fill nail holes and patch surface to match surrounding wood.
- B. Apply borate preservative treatment to accessible surfaces after replacements are made. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.
 - C. Repair remaining depressions, holes, or similar voids with patch-type repairs.
 - D. Clean spilled materials from adjacent surfaces immediately.
 - E. Glazing: Reglaze units prior to reinstallation.
 - F. Reinstall units removed for repair into original openings.
 - G. Weather Stripping: Replace nonfunctioning and install missing weather stripping to ensure full-perimeter and meeting rail weather stripping for each operable sash.

3.6 WOOD WINDOW UNIT REPLACEMENT

- A. General: Replace existing wood window units with new custom-fabricated units to match existing at locations indicated on Drawings.
- B. Apply borate preservative treatment to accessible surfaces before finishing. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.
- C. Mill glazed members to accommodate glass thickness. Glaze units prior to installation.
- D. Install units and other components as indicated on Drawings and according to manufacturer's written instructions.
- E. Install units level, plumb, square, true to line, without distortion or impeding movement, anchored securely in place to structural support, and in proper relation to wall flashing, trim, and other adjacent construction.
- F. Set sill members in bed of sealant for weathertight construction unless otherwise indicated.
- G. Install window units with new anchors into existing openings.

3.7 ADJUSTMENT

- A. Adjust existing and replacement operating sash, hardware, weather stripping, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

3.8 CLEANING AND PROTECTION

- A. Protect window, door and trim surfaces from contact with contaminating substances resulting from construction operations. Monitor window, door and trim surfaces adjacent to and below

exterior concrete and masonry during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances contact window, door and trim surfaces, remove contaminants immediately according to glass manufacturer's written recommendations.

- B. Clean exposed surfaces immediately after historic treatment of wood windows, doors and trims. Avoid damage to coatings and finishes. Remove excess sealants, glazing and patching materials, dirt, and other substances.
- C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION

SECTION 081110
HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. Standard hollow-metal steel frames.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
1. Section 042000 - UNIT MASONRY for building anchors into masonry construction.
 2. Section 081400 - WOOD DOORS for wood doors in hollow metal frames..
 3. Section 088000 - GLAZING for glazed lites.
 4. Section 092110 - GYPSUM BOARD ASSEMBLIES for insulation.
 5. Section 099000 - PAINTING AND COATING for field painting steel frames.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance rating, temperature-rise ratings, and finishes for each type of steel frame specified.
- B. Shop Drawings:
1. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 2. Locations of reinforcement and preparations for hardware.
 3. Details of each different wall opening condition.
 4. Details of anchorages, joints, field splices, and connections.
 5. Details of accessories.
 6. Details of moldings, removable stops, and glazing.
 7. Details of conduit and preparations for power, signal, and control systems.
- C. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.
- D. Qualification Data: For Installer.

- E. Product Test Reports: Based on evaluation of comprehensive fire tests performed by a qualified testing agency, for each type of standard steel frame.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain standard steel frames through one source from a single manufacturer.
- C. Fire-Rated Sidelight and Transom Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. 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. CURRIES Company; an ASSA ABLOY Group Company.
 - 2. de LaFontaine.
 - 3. Mesker Door Inc.
 - 4. Pioneer Industries, Inc.
 - 5. Philipp Manufacturing Company.
 - 6. Republic Builders Products Company.

7. Steelcraft; an Allegion (formerly Ingersoll-Rand) company.

2.2 MATERIALS

- A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- D. Metallic-Coated, (Galvanized/Galvannealed) Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60/A60 metallic coating.
- E. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- G. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.
- H. Insulation: Comply with requirements in Section 092110 - GYPSUM BOARD ASSEMBLIES.
- I. Glazing: Comply with requirements in Section 088000 - GLAZING.
- J. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD.
- K. Low-Emitting Materials, General Emissions Evaluation: GreenGuard Gold certification.

2.3 STANDARD STEEL FRAMES

- A. General: Comply with ANSI A250.8 and with details indicated for type and profile.
- B. Interior Frames: Fabricated from A40 galvanized cold-rolled steel sheet, unless otherwise indicated to comply with exterior frame requirements.
 1. Fabricate frames with full profile welded joints.
 2. Frames for Woodl Doors: 0.053-inch-thick steel sheet.
- C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.4 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
 - 3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
 - 4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

- B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 - 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.5 STOPS AND MOLDINGS

- A. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.

- B. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

2.6 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

- B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch-wide steel.

2.7 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

- B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

- C. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Full Profile Welded Frames: Weld joints continuously; grind, fill, dress, and make smooth, flush, and not visible.

2. Full Profile Welded Frames at Fire-Rated Doors and Exterior Doors: Weld joints continuously; grind, fill, dress, and make smooth, flush, and not visible.
 3. Interlocking (Knock-Down) Frames at 20-Minute-Rated Doors and Non-Rated Doors: Interlocking with visible seams.
 4. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 5. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 7. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 8. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - 5) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.
 - c. Compression Type: Not less than two anchors in each jamb.
 - d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
 9. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Section 087100 - DOOR HARDWARE.
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.

2. Reinforce frames to receive nontemplated, mortised and surface-mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 - ELECTRICAL WORK.

F. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior frames.
4. Provide loose stops and moldings on inside of hollow metal work.
5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.8 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard epoxy primer immediately after cleaning and pretreating.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
2. Refer to Section 099000 – PAINTING AND COATING for field-applied coating.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable glazing stops located on secure side of opening.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
4. Masonry Walls: Coordinate installation of frames to allow for filling space between frames and masonry with insulation.
5. Concrete Walls: Solidly fill space between frames and concrete with insulation.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
8. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for

securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.

9. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Glazing: Comply with hollow metal manufacturer's written instructions.
 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated (Galvanized) Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

SECTION 081400

WOOD DOORS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Solid-core wood doors for transparent and opaque finishes.
 - 2. Factory finishing for wood doors with transparent finish.
 - 3. Factory fitting flush wood doors to frames and factory machining for hardware.
 - 4. Louvers and glass lites for flush wood doors.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 064020 - INTERIOR ARCHITECTURAL WOODWORK for wood door frames.
 - 2. Section 099000 - PAINTING AND COATING for field finishing of opaque wood doors.

1.3 SUBMITTALS

- A. Product Data: For each type of product, including the following:
 - 1. Door core and edge construction, face type, louvers, and trim for openings.
 - 2. Factory-finishing specifications.
- B. 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 or finished and application requirements.

C. 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 finish color, sheen, and grain to be expected in finished work.
2. Frames for light openings, 6 inches long, for each material, type, and finish required.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.

B. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."

1. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

C. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies shall comply with qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

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

E. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

F. 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.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 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.

- C. Mark each door on top rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: 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.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 - 1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 2. Warranty shall include hardware installation and replacement of glass and glazing.
 - 3. Warranty shall be in effect during the following period of time from date of Substantial Completion:
 - a. Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

- A. Low-Emitting Materials: Provide wood doors in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 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. Lambton Doors; EnviroDesign Series.
 - 2. Masonite Architectural; Aspiro and Graham Series (formerly Algoma and Marshfield).
 - 3. Oregon Doors; Architectural Series.
 - 4. VT Industries Inc.; Eggers and Heritage collections.

2.3 DOOR CONSTRUCTION, GENERAL

- A. Doors for Transparent Finish:
 - 1. Grade: AWI Premium, with AWI Grade AA faces, 4 inch veneer width.
 - 2. Species and Cut: As indicated on the Drawings.
 - 3. Match between Veneer Leaves: Book match.
 - 4. Assembly of Veneer Leaves on Door Faces: Center-balance.
 - 5. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.

6. Transom Match: Continuous match.
7. Stiles: Same species as face.
8. Cross-Banding: 1/8 in. high density fiberboard, no added formaldehyde (NAF).
9. Adhesives: WDMA T.M.-6, Type I.

B. Doors for Opaque Finish:

1. Grade: Premium.
2. Faces for Interior Doors: Either medium-density overlay (MDO) or high-density fiberboard (HDF).
3. Stiles: Match face.
4. Cross-Banding: 1/8 in. high density fiberboard, no added formaldehyde (NAF).
5. Adhesives: WDMA T.M.-6, Type I.
6. Factory Primer: Manufacturer's standard water-based low VOC primer.

2.4 SOLID-CORE DOORS

A. Cores: Comply with the following requirements:

1. Composite Wood, General: CARB II compliant or made with binder containing no added formaldehyde (NAF).
2. Particle Core: ANSI A 208.1, Grade 1-LD-2.
3. Agrifiber Core: ANSI A 208.1, Grade 1-LD-2.
4. Structural Composite Lumber Core: WDMA I.S.10, Timberstrand LSL.
5. Provide doors with structural composite lumber cores instead of particleboard cores at locations where exit devices are indicated or where light or louver cutouts exceed 40% of the door area.

B. Interior Veneer-Faced Doors:

1. Construction: Five plies, hot-pressed, with stiles and rails bonded to core, then entire unit abrasive planed before veneering.

C. Fire-Rated Doors:

1. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as needed to provide fire rating indicated.
 - a. Fire Retardant Mineral Core, with no added formaldehyde cross-banding.
2. Blocking: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated as needed to eliminate through-bolting hardware.
3. Edge Construction: At hinge stiles, provide manufacturer's standard laminated-edge construction with improved screw-holding capability and split resistance and with outer stile matching face veneer.
 - a. Screw-Holding Capability: 550 lbf per WDMA T.M.-10.

4. Pairs: Provide fire-rated pairs with fire-retardant stiles matching face veneer that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals.

2.5 LOUVERS AND LIGHT FRAMES

- A. Wood Louvers: Door manufacturer's standard solid-wood louvers, unless otherwise indicated.
 1. Wood Species: Same species as door faces.
 2. Profile: Flat.
- B. Fire Door Louvers (not required on 20 min. doors): Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire rating of one and one-half hours and less.
 1. Metal and Finish: Galvanized steel, 0.0396 inch thick, hot-dip zinc coated and factory primed for paint finish.
- C. 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.
 2. Profile: 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.
- D. Wood-Veneered Beads for Light Openings in Fire Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire rating indicated. Include concealed metal glazing clips where required for opening size and fire rating indicated.

2.6 GLAZING SYSTEMS

- A. Glazing: Provide factory installed glass products in accordance with requirements in Section 088000 - GLAZING.

2.7 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:
 1. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements in NFPA 80 for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA/DHI A115-W series standards, and hardware templates.
 1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining. Drill pilot holes for screws for butt hinges and lock fronts at the factory.
 2. Metal Astragals: Factory prime and premachine astragals and formed-steel edges for hardware for pairs of fire-rated doors to receive concealed vertical rod exit devices.

- C. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
 - 1. Fabricate door and transom panels with full-width, solid-lumber meeting rails. Provide factory-installed spring bolts for concealed attachment into jambs of metal doorframes.
- D. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.
 - 1. Light Openings: Trim openings with moldings of material and profile indicated.
 - 2. Louvers: Factory install louvers in prepared openings.
 - 3. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 - GLAZING.

2.8 FACTORY FINISHING

- A. General: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated" for factory finishing.
- B. Doors for Opaque Finish: Factory prime faces and edges of doors, including cutouts, with one coat of wood primer specified in Section 099000 - PAINTING AND COATING.
- C. Doors for Transparent Finish: Factory finish doors that are indicated to receive transparent finish. Finish faces and edges of doors, including cutouts.
- D. Transparent Finish:
 - 1. Grade: Premium.
 - 2. Finish: WDMA TR-8, UV cured acrylated polyester or urethane.
 - 3. Staining: None required.
 - 4. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
 - 1. Verify that 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.
- B. Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.

1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
2. Install smoke- and draft-control doors according to NFPA 105.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements 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. Protection: Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protections and reclean as necessary immediately before final acceptance.

C. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 083110

ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Access doors and frames for floors, walls and ceilings.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 061000 - ROUGH CARPENTRY for rough openings in wood framing.
 - 2. Section 087100 - DOOR HARDWARE for rim cylinder locks and master keying.

1.3 SUBMITTALS

- A. Product Data: For each type of access door and frame indicated. Include construction details, fire ratings, materials, individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each door face material, at least 3 by 5 inches in size, in specified finish.
- D. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.
- E. Ceiling Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim are shown and coordinated with each other.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of access door and frame through one source from a single manufacturer.
- B. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics per the following

test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. NFPA 252 for vertical access doors and frames.
 2. ASTM E 119 for horizontal access doors and frames.
- C. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.5 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.1 STEEL MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
1. ASTM A 123/A 123M, for galvanizing steel and iron products.
 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
- B. Steel Sheet: Electrolytic zinc-coated, ASTM A 879/A 879M with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 - a. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
 2. Factory-Primed Finish: Apply shop primer immediately after cleaning and pretreating.
- D. Drywall Beads: Edge trim formed from 0.0299-inch zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

2.2 STAINLESS-STEEL MATERIALS

- A. Rolled-Stainless-Steel Floor Plate: ASTM A 793, manufacturer's standard finish.
- B. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 316. Remove tool and die marks and stretch lines or blend into finish.
1. Finish: Directional Satin Finish, No. 4.

2.3 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- 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. Acudor Products, Inc.
 2. Babcock-Davis.
 3. Dur-Red Products.
 4. JL Industries (a division of Activar Construction Products Group).
 5. Karp Associates, Inc.
 6. Larsen's Manufacturing Company.
 7. Milcor Inc.
 8. Nystrom, Inc.
- B. Flush Access Doors and Trimless Frames: Fabricated from steel sheet at typical areas and from stainless-steel sheet at toilet and wet areas.
1. Locations: Floors, wall and ceiling surfaces.
 2. Door: Minimum 0.060-inch-thick sheet metal, set flush with surrounding finish surfaces.
 3. Frame: Minimum 0.060-inch-thick sheet metal with drywall bead flange.
 4. Hinges: Continuous piano.
 5. Lock: Cylinder.
 - a. Lock Preparation: Prepare door panel to accept cylinder specified in Section 087100, DOOR HARDWARE.
- C. Recessed Access Doors and Trimless Frames: Fabricated from steel sheet at typical areas and from stainless-steel sheet at toilet and wet areas.
1. Locations: Wall and ceiling surfaces.
 2. Door: Minimum 0.060-inch-thick sheet metal in the form of a pan recessed 5/8 inch for gypsum board infill.
 3. Frame: Minimum 0.060-inch-thick sheet metal with drywall bead for gypsum board surfaces.
 4. Hinges: Concealed pivoting rod hinge.
 5. Lock: Cylinder.
 - a. Lock Preparation: Prepare door panel to accept cylinder specified in Section 087100, DOOR HARDWARE.
- D. Fire Rated, Uninsulated, Flush Access Doors and Frames with Exposed Trim: Fabricated from steel at typical areas and from stainless-steel sheet at toilets and wet areas.
1. Locations: Wall surfaces.
 2. Fire-Resistance Rating: Not less than that of adjacent construction.
 3. Door: Minimum 0.060-inch-thick sheet metal, flush construction.
 4. Frame: Minimum 0.060-inch-thick sheet metal with 1-inch-wide, surface-mounted trim.
 5. Hinges: Continuous piano.
 6. Automatic Closer: Spring type.
 7. Lock: Self-latching device with cylinder lock.

- a. Lock Preparation: Prepare door panel to accept cylinder specified in Section 087100, DOOR HARDWARE

2.4 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
 1. For trimless frames with drywall bead, provide edge trim for gypsum board and gypsum base securely attached to perimeter of frames.
 2. For trimless frames with plaster bead for full-bed plaster applications, provide zinc-coated expanded metal lath and exposed casing bead welded to perimeter of frames.
 3. Provide mounting holes in frames for attachment of units to metal or wood framing.
 4. Provide mounting holes in frame for attachment of masonry anchors.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.
 1. For recessed doors with plaster infill, provide self-furring expanded metal lath attached to door panel.
- E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 1. For cylinder lock, furnish two keys per lock and key all locks alike.
 2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING AND CLEANING

- A. Adjust doors and hardware after installation for proper operation.

- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 087100

DOOR HARDWARE

PART 1 GENERAL

1.1 SUMMARY

- A. Provide door hardware as scheduled.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.
- C. Submit for approval hardware schedule proposed for use based on Owner's requirements.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Hardware for Fire-Rated Openings: NFPA 80, and local requirements.
- C. Materials and Application: ANSI A156 series standards.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Door Hardware: As scheduled in the Drawings.
 - 1. Manufacturers: As scheduled in the Drawings.
 - 2. Quality Level: Heavy duty commercial.
 - 3. Locksets and Latchsets: Bored cylindrical type where indicated.
 - 4. Locksets and Latchsets: Mortise type where indicated.
 - 5. Lock Cylinders: Integral type where indicated.
 - 6. Lock Cylinders: Interchangeable type where indicated.
 - 7. Keying: Owner's requirements.
 - 8. Hinges and Butts: Full-mortise type at interior, with nonremovable pins at exterior doors.
 - 9. Closers, Door Control, and Exit Devices: Low frequency.
 - 10. Closers, Door Control, and Exit Devices: Barrier-free.
 - 11. Push/Pull Units: Through-bolted type.
 - 12. Hardware Finishes: As scheduled.
 - 13. Auxiliary Materials:
 - a. Door Trim Units: Kickplates, edge trim, viewers, knockers, and mail drops. and related trim.
 - b. Stops and overhead door holders.
 - c. Soundstripping.

- d. Weatherstripping and thresholds.
- e. Electromagnetic hold-open devices.
- f. Card-operated opening devices.
- g. Knox box for fire emergency keys.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Follow guidelines of DHI 'Recommended Locations for Builder's Hardware and hardware manufacturers' instructions.
- B. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.
- C. Adjust operation, clean and protect.

3.2 SCHEDULE

- A. Hardware Schedule: [Insert when available or delete this subparagraph.]

END OF SECTION

SECTION 088000

GLAZING

(Part of Work of Section 080002 - GLASS AND GLAZING, Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

- 1. Glass and glazing for the following products and applications:

- a. Replacement Transom Panel in Existing Frame.
- b. Unframed mirrors.
- c. Glazing film.

- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1.3 Section 064020 - INTERIOR ARCHITECTURAL WOODWORK for field applied wood frame at mirror.

1.4 DEFINITIONS

- A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.
- D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.
- E. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions.

Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

- F. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1.5 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
 - 1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
 - a. Specified Design Wind Loads: As required by Code.
 - b. Specified Design Snow Loads for Sloped Glazing: As required by Code.
 - c. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
 - 1) Load Duration: 60 seconds or less.
 - d. Probability of Breakage for Sloped Glazing: 1 lite per 1000 for lites set more than 15 degrees off vertical and under wind and snow action.
 - 1) Load Duration: 30 days.
 - e. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch, whichever is less.
 - 1) For monolithic-glass lites heat-treated to resist wind loads.
 - 2) For insulating glass.
 - 3) For laminated-glass lites.
 - f. Minimum Glass Thickness for Exterior Lites: Not less than 6 mm.
- C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
 2. For laminated-glass lites, properties are based on products of construction indicated.
 3. For insulating-glass units, properties are based on units with lites 6.0 mm thick and a nominal 1/2-inch-wide interspace.
 4. Center-of-Glass Values: Based on using LBL-44789 WINDOW 6.3 computer program for the following methodologies:
 - a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F.
 - b. Solar Heat Gain Coefficient: NFRC 200.
 - c. Solar Optical Properties: NFRC 300.

1.6 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Samples: 12-inch- square Samples for each type of glass and glass assembly, glazing sealants.
- C. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
- D. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
 1. For solar-control low-e-coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.
- E. Qualification Data: For installers.
- F. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.
- G. Product Test Reports: For each type of glazing products:
- H. Warranties: Special warranties specified in this Section.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance..
- B. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: clear float glass, laminated glass and insulating glass.

- C. Source Limitations for Glass Sputter-Coated with Solar-Control Low-E Coatings: Where solar-control low-e coatings of a primary glass manufacturer that has established a certified fabricator program is specified, obtain sputter-coated solar-control low-e-coated glass in fabricated units from a manufacturer that is certified by coated-glass manufacturer.
- D. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.
- E. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.
 - 1. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
 - 2. Test elastomeric glazing sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
- F. Preconstruction Adhesion and Compatibility Testing: Submit to elastomeric glazing sealant manufacturers, for testing indicated below, samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that will contact or affect elastomeric glazing sealants:
 - 1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 - 2. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
 - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 4. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
 - 5. Testing will not be required if elastomeric glazing sealant manufacturers submit data based on previous testing of current sealant products for adhesion to, and compatibility with, glazing materials matching those submitted.
- G. Fire-Protection-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on positive-pressure testing according to NFPA 257 or UL 9, including the hose-stream test, and shall comply with NFPA 80.
 - 1. Fire-protection-rated glazing required to have a fire-protection rating of 20 minutes shall be exempt from the hose-stream test, unless required by authorities having jurisdiction.
- H. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201.
 - 1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency] acceptable to authorities having jurisdiction.
 - 2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

- I. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA Laminated Division's "Laminated Glass Design Guide" and GANA's "Glazing Manual."
 - 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
 - 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Sloped Glazing Guidelines."
 - 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."

- J. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:
 - 1. Insulating Glass Certification Council.

- K. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup for types of windows indicated, in locations shown on Drawings.

- L. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

- B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.10 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to the Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: Ten years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form, made out to the Owner and signed by laminated-glass manufacturer agreeing to replace laminated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 1. Warranty Period: Five years from date of Substantial Completion.
- C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to the Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INSULATING-GLASS UNITS

- A. Insulating-Glass Units for Vertical Glazing: 1 inch thick (25.0 mm) insulating glass consisting of two lites of 1/4 inch (6 mm) glass, low e coating on the No. 2 surface and argon gas filled. Provide one of the following or equal:
 1. Guardian Industries; SN-68.
 - a. Visible Light Transmittance: 68 percent.
 - b. Reflectance Visible Light: 10 percent.
 - c. U Value (Winter): 0.25.
 - d. Shading Coefficient: 0.43.
 - e. Solar Heat Gain Coefficient: 0.38.
 2. Viracon; VE1-2M.
 - a. Visible Light Transmittance: 70 percent.
 - b. Reflectance Visible Light: 11 percent.
 - c. U Value (Winter): 0.25.
 - d. Shading Coefficient: 0.43.
 - e. Solar Heat Gain Coefficient: 0.37.
 3. Vitro Architectural Glass (formerly PPG Industries); Solarban 60.
 - a. Visible Light Transmittance: 70 percent.
 - b. Reflectance Visible Light: 11 percent.
 - c. U Value (Winter): 0.29.
 - d. Shading Coefficient: 0.44.
 - e. Solar Heat Gain Coefficient: 0.38.
- B. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD.

2.2 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
 - 1. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD.
- B. Low-Iron, Ultraclear Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I, complying with other requirements specified and with visible light transmission not less than 91 percent and solar heat gain coefficient not less than 0.87.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AGC Glass; Krystal Klear.
 - b. Guardian Industries Corp.; Ultrawhite.
 - c. Pilkington North America; Optiwhite.
 - d. Vitro Architectural Glass (formerly PPG Industries); Starphire.
- C. Tempered Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; Kind FT; 1/4 inch thick unless indicated otherwise.
- D. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by an argon-filled interspace, and complying with ASTM E2190 and with requirements specified in this Section.
 - 1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" paragraph.
 - 2. Provide Kind FT (fully tempered) glass lites where safety glass is indicated.
 - 3. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
 - 4. Sealing System: Dual seal, with primary and secondary sealants as follows:
 - a. Manufacturer's Standard Sealants. Butyl primary and silicone secondary sealants. Secondary sealant shall cover entire spacer bar at IGU perimeter.
 - 5. Spacer Specifications: Manufacturer's standard spacer material. Spacer corners shall be bent, soldered, or welded. Keyed spacer corners will not be accepted. Spacer may have a mid-span spacer key located at the midpoint of the insulating glass unit head. Where a mid-span spacer key is used, the key must be fully embedded (all sides) in butyl sealant.
- E. Glass Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.
 - 1. Mirror Edge Treatment: Flat polished edge.
- F. Glazing Film: Translucent, dimensionally stable, cast PVC film, 2-mil-minimum thickness, with pressure-sensitive, clear adhesive back for adhering to glass and releasable protective backing.

1. Manufacturers: Subject to compliance with requirements, available manufacturer's that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison, Graphics.
 - b. FDC Graphic Films, Inc.
 - c. Madico, Inc.
 - d. 3M Scotchcal.
2. Comply with requirements for safety glazing.
3. Use: Suitable for exterior and interior applications.
4. Patterns: As selected by Architect from manufacturer's full range.

2.3 GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:
 1. Compatibility: Verify glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, interlayer of laminated glass, 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.
 4. VOC Emissions: Provide sealants in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 5. VOC Content:
 - a. Structural Glazing Adhesives: 100 g/L.
 - b. Architectural Sealants: 250 g/L.
 6. Methylene chloride and perchloroethylene may not be intentionally added to sealants.
- B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 1. Single-Component Neutral- and Basic-Curing Silicone Glazing Sealants:
 - a. Dow Corning Corporation; 790.
 - b. GE Silicones; SilPruf LM SCS2700.
 - c. Tremco Inc.; Spectrem 1.

2.4 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for

application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for project conditions.

- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:
 - 1. Type 1, for glazing applications in which tape acts as the primary sealant.
 - 2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.5 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.
 - 1. VOC Emissions: Provide adhesives in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - 2. VOC Content: 250 g/L or less.
 - 3. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.
 - 4. Do not use adhesives that contain urea formaldehyde.
- G. Mirror Hardware, Top and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.

2.6 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with outdoor and indoor faces.
- C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing glazing, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep system.
 - 3. Minimum required face or edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Wall-Mounted Mirrors: Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
- K. Glazing Film: Apply squarely aligned to glass edges, uniformly smooth, and free from tears, air bubbles, wrinkles, and rough edges, in single sheet completely overlaying the back face of clean glass, according to manufacturer's written instructions, including surface preparation and application temperature limitations.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each glazing unit is installed.
- F. 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.

3.5 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.

3.6 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION

SECTION 092110

GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. Interior gypsum wallboard.
 2. Tile backing panels.
 3. Acoustic insulation (sound attenuation batts) in gypsum wallboard assemblies.
 4. Non-load-bearing steel framing.
 5. Installation of access panels.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
1. Section 061000 - ROUGH CARPENTRY for plywood blocking and backing panels.
 2. Section 061600 - SHEATHING for gypsum sheathing at exterior assemblies.
 3. Section 083110 - ACCESS DOORS AND FRAMES for installation in gypsum board assemblies.
 4. Section 093000 - TILING for joint compound and tape at cementitious tile backing panels.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide fire stop tracks capable of withstanding deflection within limits and under conditions indicated.
1. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: If materials and systems other than those specified and those indicated on the Drawings are proposed for use, submit shop drawings signed and sealed by a structural engineer licensed in the jurisdiction of the project certifying proposed systems meet code requirements, project requirements and the following deflection criteria:
1. For gypsum board assemblies without applied rigid finishes L/240; for gypsum board assemblies with applied rigid finishes such as tile, stone, wood paneling L/360. Lateral load

5 psf except at shafts. Lateral load at shafts shall be required based on analysis of equipment and systems using shaft.

- C. Samples: Full-size Sample in 12-inch-long length for each trim accessory indicated.

1.5 QUALITY ASSURANCE

1.6 STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are 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.

PART 2 - PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
 - 2. Protective Coating: Manufacturer's standard corrosion-resistant zinc coating, unless otherwise indicated.
 - 3. Recycled Content: Use minimum recycled content of 25%.

2.2 SUSPENSION SYSTEM COMPONENTS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch-diameter wire, or double strand of 0.0475-inch-diameter wire.
- B. Hanger Attachments to Concrete:
 - 1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.

- a. Type: Postinstalled, expansion anchor.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch-wide flanges with depth as required for span and loading and indicated on Drawings.
- E. Furring Channels (Furring Members): 0.0538-inch bare-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
- F. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
 - b. Rockfon; Chicago Metallic Drywall Grid.
 - c. USG Corporation; Drywall Suspension System.
 - 2. Performance Requirements: Ceiling support system shall support a live load of 6 psf minimum at L/240.

2.3 STEEL FRAMING FOR FRAMED ASSEMBLIES

- 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. California Expanded Metals Co. (CEMCO).
 - 2. ClarkDietrich.
 - 3. Marino\WARE.
 - 4. The Steel Network (TSN).
- B. Steel Studs and Runners: ASTM C 645.
 - 1. Minimum Base-Steel (Uncoated) Thickness: 0.0296 inches (20 gage).
 - 2. Dimpled studs meeting performance values for equivalent standard studs are acceptable.
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
 - 1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch-deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
 - 2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch-deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
 - 3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

- a. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Brady Innovations; Sliptrack Systems.
 - 2) California Expanded Metals Co. (CEMCO); CST Slotted Tracks.
 - 3) Clark Dietrich Building Systems; MaxTrak Slotted Deflection Track.
 - 4) Steel Network Inc. (The); VertiTrack VT Series.

- D. Fire Stop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness compatible with studs and in width to accommodate depth of studs.
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. California Expanded Metals Co. (CEMCO); FAS-TRK 1000 Slotted Tracks.
 - b. Clark Dietrich Building Systems; BlazeFrame Fire Stop Deflection Track.
 - c. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.

- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 1. Minimum Base-Metal Thickness: 0.0312 inch (20 gauge).

- F. Cold-Rolled Channel Bridging: 0.0538-inch bare-steel thickness, with minimum 1/2-inch-wide flanges.
 1. Depth: 1-1/2 inches.
 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

- G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 1. Minimum Base-Metal Thickness: 0.0312 inch (20 gauge).
 2. Depth: 1-1/2 inches.

- H. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission. Strictly comply with manufacturer's installation instruction.
 1. Basis of Design: ClarkDietrich; RC Deluxe, asymmetrical configuration.

- I. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches wall attachment flange of 7/8 inch, minimum bare-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

- J. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

- K. Isolation Strip at Exterior Walls: Adhesive-backed, closed-cell foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

2.4 INTERIOR GYPSUM BOARD

- 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. CertainTeed Gypsum, Inc.
 2. National Gypsum Company.
 3. United States Gypsum Company (USG).
- B. Gypsum Wallboard: ASTM C 1396.
1. Basis of Design: USG; SHEETROCK EcoSmart Panels.
 2. Thickness: 1/2 inch and 5/8 inch as indicated.
 3. Long Edges: Tapered.
- C. Gypsum Wallboard, Fire-Resistant Type X: ASTM C 1396.
1. Basis of Design: USG; SHEETROCK EcoSmart Panels Firecode X.
 2. Thickness: 5/8 inch.
 3. Long Edges: Tapered.
- D. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396. With moisture- and mold-resistant core and paper surfaces.
1. Basis of Design: USG; SHEETROCK EcoSmart Mold Tough Firecode X.
 - a. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD.
 - b. Building Product Disclosure and Optimization, Material Ingredients: Declare product labels.
 - c. Low-Emitting Materials, General Emissions Evaluation: GreenGuard Gold certification.
 2. Core: 5/8 inch, Type X.
 3. Long Edges: Tapered.
 4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.5 TILE BACKING PANELS

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed; GlasRoc Tile Backer.
 - b. Georgia-Pacific Gypsum (G-P); DensShield Tile Backer.
 - c. National Gypsum Company; Gold Bond eXP Tile Backer.
2. Thickness: 1/2 inch or 5/8 inch, as indicated.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.6 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. Expansion (control) joint.
 - e. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

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. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. Pittcon Industries.
2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.7 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.
2. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

D. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Gypsum Backing Panels: Use setting-type taping compound and setting-type, sandable topping compound.

2.8 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
1. Basis of Design: Henkel; OSI F38 Drywall and Panel Adhesive.
 2. Low-Emitting Materials: Provide adhesives in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 3. VOC Content: 50 g/L or less.
 4. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.
 5. Do not use adhesives that contain urea formaldehyde.
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 2. For fastening cementitious tile backing panels, use screws of type and size recommended by panel manufacturer.
- D. Acoustic Insulation, Sound Attenuation (Batts) Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
1. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Knauf Insulation; EcoBatt.
 - b. Owens Corning; PINK Next Gen Fiberglass Sound Attenuation Batts (SAB).
 - c. Owens Corning; Thermafiber SAFB FF.
 - d. Rockwool (formerly Roxul); AFB evo.
 2. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Sealant: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, joint sealant, recommended for sealing interior concealed joints to reduce airborne sound transmission.
1. Available Products, for Concealed and Exposed Joints: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
 - b. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
 - c. USG; SHEETROCK Acoustical Sealant.
 2. Available Products, for Concealed Joints Only: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. OSI (a division of Henkel); Pro-Series SC-175.
 - b. Pecora Corp.; BA-98.
 - c. Tremco, Inc.; Tremco Acoustical/Curtainwall Sealant.

3. Low-Emitting Materials: Provide sealants in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. VOC Content, Architectural Sealants: 250 g/L or less.
5. Methylene chloride and perchloroethylene may not be intentionally added to sealants.

2.9 IDENTIFICATION LABELS FOR FIRE- AND SMOKE-PARTITIONS

- A. Identification Labels: Self-adhesive signs, to comply with applicable local Code.
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire Wall Signs, Inc.
 - b. Marking & Identification Tape (mnitape.com).
 - c. My Safety Sign.
 - d. Safety Supply Warehouse.
 2. Text: "FIRE AND SMOKE BARRIER - PROTECT ALL OPENINGS".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.
- 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 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 indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754. Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 5. Do not attach hangers to steel roof deck.
 - 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Grid Suspension Systems: 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.

- G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.5 INSTALLING FRAMED ASSEMBLIES

- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- B. Install studs so flanges within framing system point in same direction.
- C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating 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 doorframes; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb, unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
 - 6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of not less than 2 studs at ends of arcs, place studs 6 inches o.c.
- D. Direct Furring: Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- E. Z-Furring Members:
 - 1. Erect insulation vertically and hold in place with Z-furring members spaced 24 inches 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.

3.6 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and 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 (including above ceilings), 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, except floors. 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.

3.7 APPLYING INTERIOR GYPSUM BOARD

- A. 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.
 2. On partitions/walls, apply gypsum panels to minimize end joints.
 3. On Z-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.

B. 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 1 framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated 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 stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-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.

- C. 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 recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

D. Curved Surfaces:

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.

3.8 APPLYING TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panels: Install at areas not subject to wetting and elsewhere as indicated with 1/4-inch gap where panels abut other construction or penetrations.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.9 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners, unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.
3. Curved-Edge Cornerbead: Use at curved openings.

D. Aluminum Trim: Install in locations indicated on Drawings.

3.10 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below:
 1. Level 1: Ceiling plenum areas and concealed areas not exposed to view.
 2. Level 2: Gypsum panels that are substrate for tile.
 3. Level 3: Not Used.
 4. Level 4: Panel surfaces that will be exposed to view (typical panels).
 5. Level 5: Where indicated on Drawings. Only if required by material being applied to wall.

3.11 INSTALLING IDENTIFICATION FOR FIRE- AND SMOKE-PARTITIONS

- A. Marking and Identification for Fire- and Smoke-Partitions: Permanently install as required by Code.

3.12 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, or exhibit mold growth. Repair of damaged panels in place is not acceptable.
 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

SECTION 093000

TILING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Floor, wall, and base tiles.
 - 2. Setting materials and accessories.
 - 3. Surface preparation.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 079200 - JOINT SEALANTS for sealing of movement joints in tile surfaces.
 - 2. Section 083110 - ACCESS DOORS AND FRAMES for installation in tile.
 - 3. Section 092110 - GYPSUM BOARD ASSEMBLIES for tile backing panels.

1.3 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.

1.4 PERFORMANCE REQUIREMENTS

- A. Wet Dynamic Coefficient of Friction: For flooring exposed as a walking surface, provide products with the following values as determined by testing identical products per ANSI/ NFSI B101.3 - 2012 Test Method for Measuring Wet DCOF of Common Hard-Surface Floor Materials, or ANSI 326.3 - American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Materials - 2017. Testing by other methods or earlier editions of the specified test method is not acceptable.
 - 1. Wet Dynamic Coefficient of Friction: Not less than 0.43.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of movement joints in tile substrates and finished tile surfaces.
 - 1. For feature spaces including lobbies, reception areas, corridors, and similar, include layout drawings based on field measurements.
- C. Samples for Verification:
 - 1. 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, but not fewer than four tiles. Use grout of type and in color or colors approved for completed work.
 - 2. Full-size units of each type of trim and accessory for each color and finish required.
 - 3. Stone Thresholds: 6-inch lengths.
 - 4. Metal Edge Strips: 6-inch lengths.
- D. Qualification Data: For Installer.
- E. Product Test Reports: For each tile setting product.
 - 1. Tile-setting and -grouting products.
 - 2. Certified porcelain tile.
 - 3. Slip-resistance test reports from qualified independent testing agency.

1.6 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain tile of same type and color or finish from one source or producer.
 - 1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting Materials: Obtain ingredients of a uniform quality for each membrane, mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:
 - 1. Stone thresholds.
 - 2. Metal edge strips.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.
 - 1. Review requirements in ANSI A108.01 for substrate flatness and for preparation by other trades.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed 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 avoided.
- D. Store liquid additives in unopened containers and protected from freezing.

1.8 PROJECT 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.

1.9 WARRANTY

- A. Tiling Contractor's Warranty: The tiling subcontractor shall supply Owner with a minimum two-year workmanship warranty for each tile area. In the event any work related to the tiling and setting materials is found to be defective within two years of substantial completion, the tiling contractor shall remove and replace such at no additional cost to the Owner. The tiling subcontractor's warranty obligation shall run directly to the Owner, and a copy the tiling signed warranty shall be sent to the tiling system's manufacturer.
 - 1. The duration of the tiling subcontractor's two-year warranty shall run concurrent with the tiling system's manufacturer's 25-year warranty.
- B. Tiling Systems Manufacturer's Warranty: The tiling systems manufacturer shall guarantee installed tile areas to be in a fully bonded, uncracked, flat, and watertight condition, for a period of 25 years, from the date of final acceptance of the tiling system. The warranty shall be a 25-year no dollar limit (NDL), non-prorated total system labor and material warranty. Total system warranty shall include tiling materials, related components and accessories including, but not limited to the substrate board, waterproofing and crack isolation membranes, mortars, grouts, adhesives, transition materials, and floor drain assemblies.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - 1. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.2 TILE PRODUCTS

- A. Tile Types: Refer to Finish Schedule for Basis of Design..
- B. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, 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.
- C. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.
- D. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes selected from manufacturer's standard shapes.

2.3 THRESHOLDS AND EDGE STRIPS

- A. Thresholds: 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. Marble Thresholds: ASTM C 503/C 503M, with a minimum abrasion resistance of 10 according to ASTM C 1353 or ASTM C 241/C 241M and with honed finish.
 - 1. Description: Uniform, fine- to medium-grained white stone with gray veining.
- C. Metal Edge Strips and Flooring Transitions: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and resilient base, designed specifically for flooring applications.
 - 1. Basis of Design: Schluter Systems.
 - 2. Material: ASTM B 221, extruded aluminum, with clear anodized satin finish.
 - 3. Material: ASTM A 666, stainless steel, 300 series, with No. 4 satin finish.

2.4 SETTING MATERIALS

- 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. Custom Building Products.
 - 2. Laticrete International, Inc.
 - 3. MAPEI Corporation.
- B. Trowelable Underlayments and Patching Compounds, for Concrete Substrates: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- C. Waterproofing and Crack Isolation Membrane: Manufacturer's standard product, 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.

- D. Modified Dry-Set (formerly Latex-Portland Cement) Mortar (Thinset): ANSI A118.4.
1. For Exterior Glue Plywood (EGP) Modified Dry-Set Mortar, comply with ANSI A118.11.
 2. For Large and Heavy Tile, Improved Modified Dry-Set Mortars, comply with ANSI A118.15.
 3. Provide prepackaged, dry-mortar mix containing dry, redispersible, acrylic additive to which only water must be added at Project site.
 4. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to other requirements in ANSI A118.4.
- E. Medium-Bed, Latex-Portland Cement Mortar: Provide materials composed as follows, with physical properties equaling or exceeding those required for thin-set mortars based on testing of medium-bed specimens according to ANSI A118.4:
1. Prepackaged dry-mortar mix containing dry, redispersible, ethylene vinyl acetate additive to which only water must be added at Project site.
 2. Prepackaged dry-mortar mix combined with liquid-latex additive.
 3. Product: Laticrete 220 Medium Bed Mortar with 333 Superflex, or approved equal.
- F. Mesh Tape for Tile Backing Panels: Alkali-resistant type, as recommended by panel manufacturer.
- G. Tile Grout, Cementitious Type: ANSI A118.7, liquid-latex form for addition to prepackaged dry-grout mix.
1. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Custom Building Products; Polyblend.
 - b. Laticrete; Permacolor Select.
 - c. MAPEI; Keracolor.
 2. Cementitious Grout Types:
 - a. Unsanded grout mixture for joints 1/8 inch and narrower.
 - b. Sanded grout mixture for joints 1/8 inch and wider.
 3. Color: To be selected by Architect from manufacturer's full range.
 4. Low-Emitting Materials, General Emissions Evaluation: Provide membranes in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - a. VOC Content, Ceramic, Glass, Porcelain, and Stone Tile Adhesives: 65 g/L or less.
 - b. GreenGuard Gold certification.
- H. 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.

- I. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints that does not change color or appearance of grout.

2.5 ELASTOMERIC SEALANTS

- A. Joint Sealants: Refer to Section 079200 - JOINT SEALANTS.
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

2.6 MIXING MORTARS AND GROUT

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 3. 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 and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.
- B. Provide concrete substrates for tile floors that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.
 1. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.
 2. Remove protrusions, bumps, and ridges by sanding or grinding.

- C. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.
- D. 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.
- E. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 TILING INSTALLATION, GENERAL

- A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.
- B. Membrane Installation:
 - 1. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness bonded securely to substrate.
 - 2. Install crack-isolation membrane to comply ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness bonded securely to substrate.
 - 3. Do not install tile over membrane until membrane has cured and been tested to determine that it is watertight.
- C. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. Follow procedures in ANSI A108 series of tile installation standards for providing minimum percent levels of mortar coverage.
 - 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.
 - 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.
- D. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

1. 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.
 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
- E. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- F. Expansion (Movement) Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated 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.
 2. Prepare joints and apply sealants to comply with requirements in Section 079200 - JOINT SEALANTS.
- G. Stone Thresholds: Install stone thresholds at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise indicated.
1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in mortar (thinset).
 2. Do not extend membranes under thresholds set in mortar. Fill joints between such thresholds and adjoining tile set on membrane with elastomeric sealant.
- H. Metal Edge Strips and Flooring Transitions: Install at locations indicated and where exposed edge of tile flooring meets other flooring that finishes flush with top of tile and no threshold is indicated.
- I. Floor Sealer: Apply floor sealer to grout joints according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.
- 3.4 CLEANING AND PROTECTING
- 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 according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
 3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

- C. 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.
- D. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed. After seven days, cover areas subject to construction traffic with heavy cardboard.
- E. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

3.5 TILE INSTALLATION SCHEDULE

- A. This schedule refers to Tile Installation Methods specified in the TCNA Handbook.
- B. Floor Tile Over Wood Subflooring, at Bathrooms, Kitchens, and Toilet Rooms: TCNA F144 and ANSI A108.5.
 - 1. Tile Type: Refer to Finish Schedule.
 - 2. Mortar: Thinset.
 - 3. Grout: Polymer-modified unsanded grout.
 - 4. Joint Width: 1/8 inch.
 - 5. Waterproofing membrane.
 - 6. Cementitious tile backing panels.
- C. Wall Tile, Typical Over Glass Mat Gypsum Tile Backing Panels: TCNA W243 and ANSI A108.5.
 - 1. Tile Type: Refer to Finish Schedule.
 - 2. Mortar: Thinset.
 - 3. Grout: Polymer-modified unsanded grout.
 - 4. Joint Width: 1/8 inch.

END OF SECTION

SECTION 095100
ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. Acoustical ceiling tiles and panels.
 2. Suspension systems, grid systems and ceiling hangers.
 3. Acoustical sealant at edge moldings at acoustical ceilings.
- B. Alternates: Refer to Drawings and Section 012300 - ALTERNATES for requirements.
- C. Related Work: The following items are not included in this Section and are specified under the designated Sections:
1. Section 092110 - GYPSUM BOARD ASSEMBLIES for gypsum board ceilings and soffits.
 2. Division 21 - FIRE SUPPRESSION for fire-suppression components located in ceilings.
 3. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING for air handling and distribution components located in ceilings.
 4. Division 26 - ELECTRICAL for light fixture and alarm system components located in ceilings.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
1. Ceiling suspension members.
 2. Method of attaching hangers to building structure. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 4. Minimum Drawing Scale: 1/4 inch = 1 foot.
- C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of 6 inch square Samples of each type, color, pattern, and texture.
 2. Exposed Suspension System Members, Moldings, and Trim: Set of 12 inch long Samples of each type, finish, and color.
- D. Asbestos Certification: Manufacturer's written certification that acoustical ceiling products contain no asbestos (0.0000%). Product labels indicating that it is the user's responsibility to test the products for asbestos are unacceptable and sufficient cause for rejection of the product on site.
- E. Maintenance Data: For finishes to include in maintenance manuals.
- 1.4 QUALITY ASSURANCE
- A. Source Limitations:
1. Acoustical Ceiling Panels: Obtain each type through one source from a single manufacturer.
 2. Suspension Systems: Obtain each type through one source from a single manufacturer.
 3. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 2. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
 3. Identify materials with appropriate markings of applicable testing and inspecting agency.
 4. Surface-Burning Characteristics: Provide acoustical panels complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84.
- C. Mockups: Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.
1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

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

1.7 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 BASIS-OF-DESIGN

- A. Basis-of-Design Products: Refer to the Finish Schedule on the Drawings.

2.2 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. Armstrong Ceilings.
 - 2. CertainTeed Ceilings.
 - 3. USG.
 - 4. .

2.3 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Ceiling Type (ACT-1): General office use and as indicated.
 - 1. Manufacturer and Model Number:
 - a. USG, Mars ClimaPlus No. 86985.
 - b. Certainteed Ceilings, Symphony M. 1222F-OVT-1.
 - c. Armstrong, Ultima No. 1912.
 - 2. Panel Size: 24 inches by 24 inches by 3/4 inch.
 - a. Panel Mounting: Revealed edge.
 - b. Noise Reduction Coefficient (NRC): Not less than 0.70.
 - c. Ceiling Attenuation Class (CAC): Not less than 35.
 - d. Color: White.
 - e. Grid Material: Painted steel.
 - f. Grid Face Width: 9/16 inch.

2.4 METAL SUSPENSION SYSTEMS

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
1. Structural Classification: Intermediate-duty system.
 2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
 3. Face Design: Flat, flush.
 4. Cap Material: Steel or aluminum cold-rolled sheet.
 5. Color: White, prefinished.
 6. Grid Face Width: As specified with ACT type.
 7. Recycled Content: Use minimum recycled content of 25%.
- B. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.
1. Anchors in Concrete: Anchors with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency; zinc-plated for Class SC1 service.
 - a. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.
- C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - a. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106 diameter wire.
- D. Hold-Down Clips: At vestibules and areas subject to wind uplift, provide manufacturer's standard hold-down clips spaced 24 inches on all cross tees.

2.5 METAL EDGE MOLDINGS AND TRIM

- A. Roll-Formed Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.
1. 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.

2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
3. For narrow-face suspension systems, provide suspension system and manufacturer's standard edge moldings that match width and configuration of exposed runners.

B. Suspension Trim: Subject to compliance with requirements, provide one of the following:

1. Armstrong World Industries, Inc.; Axiom.
2. CertainTeed Ceilings; Approved equal.
3. USG Interiors, Inc.; Compasso.

2.6 ACOUSTICAL SEALANT

A. Acoustical Sealant, for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, joint sealant, recommended for sealing interior concealed joints to reduce airborne sound transmission.

1. Available Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. OSI (a division of Henkel); Pro-Series SC-175.
 - b. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
 - c. Pecora Corp.; BA-98.
 - d. Specified Technologies, Inc. (STI); Smoke N Sound Acoustical Sealant.
 - e. USG; SHEETROCK Acoustical Sealant.
2. Low-Emitting Materials: Provide adhesives and sealants in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
3. VOC Content, Architectural Sealants: 250 g/L or less.
4. Methylene chloride and perchloroethylene may not be intentionally added to sealants.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636 per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
 - 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. 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.
 - 6. Do not attach hangers to steel deck tabs.
 - 7. Space hangers not more than 48 o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 - 1. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 - 2. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.

3.4 CLEANING

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

END OF SECTION

SECTION 096510

RESILIENT FLOORING AND ACCESSORIES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Resilient flooring.
 - 2. Resilient wall base and accessories.
 - 3. Substrate preparation for resilient flooring and accessories.
 - 4. High-performance adhesive suitable for RH and pH measured in substrate.
- B. Alternates: Refer to Drawings and Section 012300 - ALTERNATES for requirements.

1.3 PERFORMANCE REQUIREMENTS

- A. Wet Dynamic Coefficient of Friction: For flooring exposed as a walking surface, provide products with the following values as determined by testing identical products per ANSI/ NFSI B101.3 - 2012 Test Method for Measuring Wet DCOF of Common Hard-Surface Floor Materials, or ANSI 326.3 - American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Materials - 2017. Testing by other methods or earlier editions of the specified test method is not acceptable.
 - 1. Wet Dynamic Coefficient of Friction: Not less than 0.43.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each type of floor covering. Include floor covering layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - 1. Show details of special patterns.
- C. Samples for Verification: Full-size units of each color and pattern of resilient flooring required.
 - 1. Resilient Wall Base and Accessories: Manufacturer's standard-size Samples, but not less than 12 inches long, of each resilient product color and pattern required.
- D. Maintenance Data: For resilient products to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.6 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. Store tiles on flat surfaces.

1.7 PROJECT CONDITIONS

- A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during floor covering installation.
- D. Close spaces to traffic for 48 hours after floor covering installation.
- E. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 BASIS-OF-DESIGN

- A. Basis-of-Design Products: Refer to the Finish Schedule on the Drawings.

2.2 LUXURY VINYL TILE FLOOR COVERING

- 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. Armstrong World Industries, Inc.
 - 2. Congoleum Corporation.
 - 3. Mannington Mills, Inc.
 - 4. Tarkett, Inc.
- B. Luxury Vinyl Tile Floor Covering: ASTM F 1700.
 - 1. Thickness: 0.080 inch.
 - 2. Size: 18 by 18 inches.

3. Style and Colors: As indicated on the Finish Schedule.

2.3 RESILIENT WALL BASE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. American Biltrite Flooring; AB Pure.
 2. Johnsonite, a division of Tarkett.
 3. Nora Systems, Inc.
- B. Resilient Wall Base: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous). Do not use polyvinyl chloride (PVC).
 1. Shape: Straight (toeless) at carpet and coved at concrete and resilient flooring.
 2. Minimum Thickness: 0.125 inch.
 3. Height: 4 inches.
 4. Lengths: Cut lengths 48 inches long or coils in manufacturer's standard length.
 5. Outside Corners: Premolded.
 6. Inside Corners: Premolded.
 7. Surface: Smooth.
 8. Style and Colors: As indicated on the Finish Schedule.
 9. Material Ingredients: Cradle to Cradle (C2C) certification or Declare product label. PVC, phthalate-, chlorine-, and halogen-free.
 10. Low-Emitting Materials: FloorScore certification.

2.4 RESILIENT MOLDING ACCESSORY

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. American Biltrite Flooring; AB Pure.
 2. Johnsonite, a division of Tarkett.
 3. Nora Systems, Inc.
- B. Types Include the Following as Applicable: Cap for cove carpet, cap for cove resilient sheet floor covering, carpet edge for glue-down applications, nosing for carpet, nosing for resilient floor covering, reducer strip for resilient floor covering, joiner for tile and carpet.
 1. Material: Rubber.
 2. Profile and Dimensions: As indicated.

2.5 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.
 1. Available Products: Mapei; Mapecem Premix.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

1. Low-Emitting Materials: Provide adhesives in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - a. VOC Content: 50 g/L or less.
 - b. Methylene chloride and perchloroethylene may not be intentionally added to adhesives. Do not use adhesives that contain urea formaldehyde.
 2. Adhesives, for Wall Base:
 - a. Available Products: Subject to compliance with requirements, provide one of the following products:
 - 1) Forbo; L910W Wall Adhesive.
 - 2) Johnsonite; 960 Cove Base Adhesive.
- C. Seamless-Installation Accessories:
1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
 - a. Color: Match floor covering.
- D. Integral-Flash-Cove-Base Accessories:
1. Cove Strip: 1-inch radius provided or approved by manufacturer.
 2. Cap Strip: Provided or approved by manufacturer.
- E. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
1. Verify 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.
 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Alkalinity and Adhesion Testing: Perform tests recommended by flooring manufacturer. Proceed with installation only after substrate alkalinity falls within a range on pH scale not less than 5 or more than 9 pH, or as otherwise required in writing by manufacturer of flooring.
 3. Moisture Vapor Emission Testing:
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours, or as otherwise required in writing by manufacturer of flooring.
 4. Relative Humidity Testing:
 - a. Perform relative humidity test, ASTM F 2170. Proceed with installation only after substrates have a maximum relative humidity level of 75 percent, or as otherwise required in writing by manufacturer of flooring.
 5. Perform tests indicated above and as recommended by flooring manufacturer. Proceed with installation only after substrates pass testing.
- C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
 1. Slope floor where indicated on Drawings.
- E. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
 1. Do not install resilient products until they are same temperature as space where they are to be installed.
- F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 TILE INSTALLATION

- A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 1. Lay tiles in pattern indicated.
- B. Match 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.

- C. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, edgings, doorframes, thresholds, and nosings.
- D. Extend tiles into toe spaces, door reveals, closets, and similar openings.
- E. 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, nonstaining marking device.
- F. Install tiles on covers for telephone and electrical ducts and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of tile installed on covers. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- G. Adhere tiles to flooring 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.

3.4 RESILIENT WALL BASE INSTALLATION

- A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- D. Do not stretch wall base during installation.
- E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.
- F. Premolded Corners: Install premolded corners before installing straight pieces.

3.5 RESILIENT ACCESSORY INSTALLATION

- A. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

3.6 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
 - a. Do not wash surfaces until after time period recommended by manufacturer.

- B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
1. Do not apply protective floor polish.
 2. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Completion.
 3. Do not move heavy and sharp objects directly over surfaces. Place hardboard or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION

SECTION 098430
SOUND-ABSORBING PANELS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Back-mounted acoustical wall panels.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 061000 - ROUGH CARPENTRY for wood blocking.
 - 2. Section 095100 - ACOUSTICAL CEILINGS for acoustical ceiling panels supported by exposed suspension system and tested for noise reduction.

1.3 DEFINITIONS

- A. NRC: Noise reduction coefficient.

1.4 SUBMITTALS

- A. Product Data: For each type of panel edge, core material, and mounting indicated.
- B. Shop Drawings: For acoustical wall panels. Include mounting devices and details; details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Include elevations showing panel sizes and direction of fabric weave and pattern matching. Indicate panel edge and core materials.
- C. Coordination Drawings: Show intersections with wall base, electrical receptacles and switches, and other adjacent work.
- D. Samples for Initial Selection: For each type of fabric facing material from acoustical wall panel manufacturer's full range.
- E. Samples for Verification: For the following products. Prepare Samples from same material to be used for the Work.
 - 1. Fabric: Full-width by 36-inch-long Sample from dye lot to be used for the Work, and as follows:

- a. With specified treatments applied.
 - b. Show complete pattern repeat.
 - c. Mark top and face of fabric.
2. Panel Edge: 12-inch-long Sample showing edge profile, corner, and finish.
 3. Core Material: 12-inch-square Sample showing corner.
 4. Mounting Device: Full-size Sample.
 5. Sample Panels: No larger than 36 by 36 inches. Show joints and mounting methods.
- F. Product Certificates: For each type of acoustical wall panel, signed by product manufacturer.
- G. Qualification Data: For fabricator and testing agency.
- H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of acoustical wall panel.
- I. Maintenance Data: For acoustical wall panels to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal recommendations.
- J. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Source Limitations: Obtain acoustical wall panels through one source from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide acoustical wall panels with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 450 or less.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and acoustical wall panel manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and panels in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.
- C. Protect panel edges from crushing and impact.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical wall panels until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Lighting: Do not install acoustical wall panels until a permanent level of lighting is provided on surfaces to receive acoustical wall panels.
- C. Air-Quality Limitations: Protect acoustical wall panels from exposure to airborne odors, such as tobacco smoke, and install panels under conditions free from odor contamination of ambient air.
- D. Field Measurements: Verify locations of acoustical wall panels by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of acoustical wall panels that fail in performance, materials, or workmanship within specified warranty period.
 - 1. Failure in performance includes, but is not limited to, acoustical performance.
 - 2. Failures in materials include, but are not limited to, fabric sagging, distorting, or releasing from panel edge; or warping of core.
 - 3. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 BASIS-OF-DESIGN PRODUCTS

- A. Basis-of-Design Products: Refer to the Finish Schedule on the Drawings.

2.2 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Decoustics Ltd.
 - 2. Kinetics Noise Control.
 - 3. Mahram Acoustical Panels a part of Miller Knoll.
 - 4. MBI Products Company.
 - 5. Quiet Concepts, a division of PCI Industries.
 - 6. Sound Concepts.
 - 7. Wall Technology, an Owens Corning Company.

2.3 CORE MATERIALS

- A. Glass-Fiber Board: ASTM C 612, Type IA or Types IA and IB; density as specified, unfaced, dimensionally stable, molded rigid board, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

1. Nominal Core Density: 4 to 7 lb/cu. ft.
- 2.4 BACK-MOUNTED, EDGE-REINFORCED ACOUSTICAL WALL PANELS WITH GLASS-FIBER BOARD CORE
- A. Panel Construction: Manufacturer's standard panel construction consisting of facing material laminated to front face, edges, and back border of dimensionally stable, rigid glass-fiber board core; with edges chemically hardened to reinforce panel perimeter against warpage and damage.
 1. Nominal Core Thickness: 1 inch
 2. Overall System NRC: Not less than 0.80, for Type A mounting per ASTM E 795.
 3. Panel Width: As indicated on Drawings
 4. Panel Height: Fabricated height as indicated on Drawings.
 5. Panel Edge Detail: Square.
 6. Corner Detail: Square to form continuous profile to match edge detail.
 - B. Facing Material: Fabric from same dye lot; color and pattern as selected by Architect from manufacturer's full range.
 1. Manufacturer: As indicated on the Finish Schedule.
 - C. Back-Mounting Devices: Concealed on backside of panel, recommended to support weight of panel, and as follows:
 1. As recommended by manufacturer.
- 2.5 FABRICATION
- A. Sound-Absorption Performance: Provide acoustical wall panels with minimum NRCs indicated, as determined by testing per ASTM C 423 for mounting type specified.
 - B. Acoustical Wall Panels: Panel construction consisting of facing material adhered to[face,] edges and back border of dimensionally stable core; with rigid edges to reinforce panel perimeter against warpage and damage.
 1. Glass-Fiber Board: Resin harden areas of core for attachment of mounting devices.
 - C. Fabric Facing: Stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other foreign matter. Applied with visible surfaces fully covered.
 1. Where square corners are indicated, tailor corners.
 2. Where radius or other nonsquare corners are indicated, attach facing material so there are no seams or gathering of material.
 3. Where fabrics with directional or repeating patterns or directional weave are indicated, mark fabric top and attach fabric in same direction so pattern or weave matches in adjacent panels.
 - D. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:
 1. Thickness.

2. Edge straightness.
3. Overall length and width.
4. Squareness from corner to corner.
5. Chords, radii, and diameters.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fabric, substrates, blocking, and conditions, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of acoustical wall panels.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install acoustical wall panels in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with acoustical wall panel manufacturer's written instructions for installation of panels using type of concealed mounting accessories indicated or, if not indicated, as recommended by manufacturer. Anchor panels securely to supporting substrate.
- C. Match and level fabric pattern and grain among adjacent panels.
- D. Installation Tolerances: As follows:
 1. Variation from Level and Plumb: Plus or minus 1/16 inch.
 2. Variation of Panel Joints from Hairline: Not more than 1/16 inch wide.

3.3 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels with fabric facing, on completion of installation, to remove dust and other foreign materials according to manufacturer's written instructions.

3.4 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, to ensure that acoustical wall panels are without damage or deterioration at time of Substantial Completion.
- B. Replace acoustical wall panels that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION

SECTION 099000

PAINTING AND COATING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Field painting of exposed interior items and surfaces.
2. Field painting of exposed exterior items and surfaces.
3. Surface preparation for painting.

- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 064020 - INTERIOR ARCHITECTURAL WOODWORK for shop priming interior architectural woodwork.
2. Section 078100 - APPLIED FIREPROOFING for intumescent fire-resistive coatings.
3. Section 080152 - HISTORIC TREATMENT OF WOOD WINDOWS AND DOORS for preparation for finishing of historical wood windows and doors.
4. Section 081110 - HOLLOW METAL DOORS AND FRAMES for factory priming steel doors and frames.
5. Section 081400 - FLUSH WOOD DOORS for factory finishing.
6. Section 092110 - GYPSUM BOARD ASSEMBLIES for surface preparation of gypsum board.

1.3 DEFINITIONS AND EXTENT

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

- B. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.

1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- C. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
- D. Do NOT paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
1. Prefinished items include the following factory-finished components:
 - a. Architectural woodwork.
 - b. Acoustical wall panels.
 - c. Toilet enclosures.
 - d. Metal lockers.
 - e. Kitchen appliances.
 - f. Elevator entrance doors and frames.
 - g. Elevator equipment.
 - h. Finished mechanical and electrical equipment.
 - i. Light fixtures.
 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Foundation spaces.
 - b. Furred areas.
 - c. Ceiling plenums.
 - d. Utility tunnels.
 - e. Pipe spaces.
 - f. Duct shafts.
 - g. Elevator shafts.
 3. Finished metal surfaces include the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - d. Copper and copper alloys.
 - e. Bronze and brass.
 4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.

5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.4 SUBMITTALS

- A. Product Data: For each paint system indicated. Include block fillers and primers.
 1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - a. Disclose material ingredients by name and Chemical Abstract Service (CAS) Registry Number.
 2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
- B. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
 1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
 2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
 3. Submit two 8 inch by 12 inch Samples for each type of finish coating for Architect's review of color and texture only.
- C. Qualification Data: For Applicator.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.
- C. Mockups: Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.
 1. Architect will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.
 - a. Wall Surfaces: Provide samples on at least 100 sq. ft.
 - b. Small Areas and Items: Architect will designate items or areas required.
 2. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.

- a. After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.

3. Final approval of colors will be from benchmark samples.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
 1. Product name or title of material.
 2. Product description (generic classification or binder type).
 3. Manufacturer's stock number and date of manufacture.
 4. Contents by volume, for pigment and vehicle constituents.
 5. Thinning instructions.
 6. Application instructions.
 7. Color name and number.
 8. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.
 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.7 PROJECT CONDITIONS

- A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.
- B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.
- C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.8 EXTRA MATERIALS (ATTIC STOCK)

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Paint: Furnish one unopened gallon of each type of paint and coating work, in color and gloss as used for the Project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work are listed in the Finish Schedule at the end of this Section.

2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- C. Paint Colors (PT-#): Refer to Finish Schedule.
- D. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. VOC Content Limits, for Interior Paints and Coatings:
1. Default: 50 g/L.
 2. Dry-Fog Coatings: 50 g/L.
 3. Flats: 50 g/L.
 4. Floor Coatings: 50 g/L.
 5. Industrial Maintenance (IM) Coatings: 100 g/L.
 6. Color indicating safety coatings: 480 g/L.
 7. Zinc rich IM primers: 100 g/L.
 8. Metallic pigmented coatings: 150 g/L.
 9. Multi-color coatings: 250 g/L.
 10. Non-flat coatings: 50 g/L.
 11. Pre-treatment wash primers: 420 g/L.
 12. Primers, sealers and undercoaters: 100 g/L.
 13. Shellacs, Clear: 730 g/L.
 14. Shellacs, Pigmented: 550 g/L.
 15. Specialty Primers: 100 g/L.
 16. Stains: 100 g/L.
 17. Stains, Interior: 250 g/L.
 18. Wood Coatings, Varnish: 275 g/L.
 19. Wood Coatings, Sanding Sealer: 275 g/L.
 20. Wood Coatings, Lacquer: 275 g/L.
 21. Wood Conditioners: 100 g/L.

22. Colorant Added to Architectural Coatings, excluding IM coatings: 50 g/L.
23. Colorant Added to Solvent Based IM: 600 g/L.
24. Colorant Added to Waterborne IM: 50 g/L.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.
 1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.2 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions and technical bulletins for each particular substrate condition and as specified.
 1. Provide barrier coats over incompatible primers or remove and reprime.
 2. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.

- b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
 - c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.
 3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
 - c. If transparent finish is required, backprime with clear sealer.
 - d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
 - e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
 4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
 - a. Exterior Exposed Steel: Clean steel surfaces in accordance with SSPC-SP 6/NACE No. 3 Commercial Blast Cleaning. Abrasive blast cleaned surfaces shall exhibit a uniform, angular profile of 1.5-3.0 mils. Prime cleaned surfaces within 8 hours and prior to surface rusting.
 - b. Interior Exposed Steel, in Humid Environments: Clean steel surfaces in accordance with SSPC-SP 6/NACE No. 3 Commercial Blast Cleaning. Abrasive blast cleaned surfaces shall exhibit a uniform, angular profile of 1.5-3.0 mils. Prime cleaned surfaces within 8 hours and prior to surface rusting.
 - c. Interior Exposed Steel, in Dry Environments: Clean steel surfaces in accordance with SSPC-SP2 or SP3 Hand or Power Tool Cleaning.
 5. Galvanized Surfaces: Clean galvanized surfaces in accordance with SSPC-SP16 Brush off Blast Cleaning of Galvanized Steel and NonFerrous Metals, to achieve a minimum 1 mil anchor profile.
- D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 3. Use only thinners approved by paint manufacturer and only within recommended limits.

- E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
 - 1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
 - 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 - 3. Provide finish coats that are compatible with primers used.
 - 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convactor covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 - 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 - 7. Paint backsides of access panels and removable or hinged covers to match exposed surfaces.
 - 8. Finish exterior doors and doors in wet areas on tops, bottoms, and side edges the same as exterior faces.
 - 9. Sand lightly between each succeeding enamel or varnish coat.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
 - 1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 - 2. Omit primer over metal surfaces that have been shop primed and touchup painted.
 - 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 - 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
 - 1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 - 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.

3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
- F. Mechanical items to be painted include, but are not limited to, the following:
 1. Uninsulated metal piping.
 2. Uninsulated plastic piping.
 3. Pipe hangers and supports.
 4. Tanks that do not have factory-applied final finishes.
 5. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 6. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
 7. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
- G. Electrical items to be painted include, but are not limited to, the following:
 1. Switchgear.
 2. Panelboards.
 3. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- H. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
- I. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- K. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
 1. Provide satin finish for final coats.
- L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 FIELD QUALITY CONTROL

- A. The Owner reserves the right to invoke the following test procedure at any time and as often as the Owner deems necessary during the period when paint is being applied:
 - 1. The Owner will engage a qualified independent testing agency to sample paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.
 - 2. Testing agency will perform appropriate tests for the following characteristics as required by the Architect.
 - 3. The Architect may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Contractor shall remove noncomplying paint from Project site, pay for testing, and repaint surfaces previously coated with the noncomplying paint. If necessary, Contractor may be required to remove noncomplying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

3.5 CLEANING

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

3.6 PROTECTION

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

3.7 PAINT SCHEDULE

- A. Schedule: Provide products and number of coats specified. Use of manufacturer's proprietary product names to designate colors, materials, generic class, standard of quality and performance criteria and is not intended to imply that products named are required to be used to the exclusion of equivalent performing products of other manufacturers.
- B. Exterior Paint Schedule:
 - 1. Exterior Wood for Painted Finish:
 - a. Factory Primed per Section 062010 - EXTERIOR FINISH CARPENTRY.
 - b. One Coat, Primer:
 - 1) California Paint Grip-Coat Bonding Primer 505 series.
 - 2) Duron Bond N-Seal Exterior Acrylic Latex Primer 08-124.

- 3) Moore; Ultra Spec Exterior Primer N558.
- 4) S-W; Exterior Latex Acrylic Wood Primer.

c. And Two Coats, Flat Finish:

- 1) California Paint Fresh Coat 100% Acrylic Velvet Flat 450 series.
- 2) Duron Weathershield Exterior 100% Acrylic Flat House Paint 34-914.
- 3) Moore; Ultra Spec EXT Flat Finish N447.
- 4) S-W; SuperPaint VinylSafe Exterior Latex Acrylic Flat A80 series.

d. And Two Coats, Semi-Gloss Finish:

- 1) California Paint Fresh Coat 100% Acrylic Satin-Gloss 471 series.
- 2) Duron Weathershield Exterior 100% Acrylic Semi-Gloss House Paint.
- 3) Moore; Ultra Spec EXT Gloss Finish N449.
- 4) PPG; Speedhide semi-gloss finish 6-900XI.
- 5) S-W; SuperPaint VinylSafe Exterior Latex Acrylic Satin A89 series.

C. Interior Paint Schedule, Typical:

1. Interior Gypsum Wallboard (GWB), Latex Paint Finish:

a. One Coat, Primer: MPI 50 X-Green and 149 X-Green.

- 1) Moore; Ultra Spec 500 Interior Latex Primer N534.
- 2) PPG; Pure Performance Interior Latex Primer 9-900.
- 3) PPG; Speedhide Zero VOC Interior Primer 6-4900XI series.
- 4) PPG; Speedhide Pro EV Zero VOC Interior Primer 12-900XI series.
- 5) S-W; ProMar 200 HP Zero VOC Interior Primer.

b. And Two Coats, Flat Finish: At ceilings and elsewhere as indicated. MPI 53 X-Green.

- 1) Moore; Ultra Spec 500 Interior Latex Flat T536.
- 2) PPG; Speedhide Zero VOC Interior Latex Flat 6-4110XI series.
- 3) PPG; Speedhide Pro EV Zero VOC Interior Latex Flat 12-110XI series.
- 4) S-W; ProMar 400 HP Zero VOC Interior Flat.

or

c. And Two Coats, Eggshell Finish: At walls and elsewhere as indicated. MPI 144 X-Green.

- 1) Moore; Ultra Spec 500 Interior Latex Eggshell T538.
- 2) PPG; Speedhide Zero VOC Interior Latex Eggshell 6-4310XI series.
- 3) PPG; Speedhide Pro EV Zero VOC Interior Latex Eggshell 12-110XI series.
- 4) S-W; ProMar 200 HP Zero VOC Interior Eg-Shel.

or

d. And Two Coats, Semi-Gloss Finish: At toilet rooms, other wet areas, and elsewhere as indicated. MPI 54 X-Green.

- 1) Moore; Ultra Spec 500 Interior Latex Semi-Gloss T546.
- 2) PPG; Speedhide Zero VOC Interior Latex Semi-Gloss 6-4510XI series.

- 3) PPG; Speedhide Pro EV Zero VOC Interior Latex Semi-Gloss 12-110XI series.
 - 4) S-W; ProMar 200 HP Zero VOC Interior Semi-Gloss.
2. Interior Architectural Woodwork, Finish Carpentry, and Wood Doors (softwoods, paint grade hardwoods, MDF, MDO, and hardwood veneers), Latex Paint Finish:
 - a. One Coat, Primer:
 - 1) Moore; Ultra Spec 500 Interior Latex Primer N534.
 - 2) PPG; Pure Performance Interior Latex Primer 9-900.
 - 3) PPG; Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer 17-921 series.
 - 4) PPG; Speedhide Zero VOC Interior Primer 6-4900XI series.
 - 5) PPG; Speedhide Pro EV Zero VOC Interior Primer 12-900XI series.
 - 6) S-W; ProMar 200 HP Zero VOC Interior Primer.
 - b. And Two Coats, Semi-Gloss:
 - 1) Moore; Ultra Spec 500 Interior Latex Semi-Gloss T546.
 - 2) PPG; Speedhide Zero VOC Interior Latex Semi-Gloss 6-4510XI.
 - 3) S-W; ProMar 200 HP Zero VOC Interior Semi-Gloss.
3. Interior Architectural Woodwork, Finish Carpentry and Millwork (hardwoods and hardwood veneers, except paint grade and factory-finished items), Transparent Polyurethane Finish:
 - a. Sand: 120 grit sandpaper.
 - b. Sand: 220 grit sandpaper.
 - c. One Coat, Stain: Not Used.
 - d. And Three Coats, Satin Finish:
 - 1) American Formulating & Manufacturing; Safecoat Polyureseal BP.
 - 2) Imperial Paints; ECOS Clear Varnish.
 - 3) Moore; Benwood Stays Clear Acrylic Polyurethane Low Lustre W423.
 - 4) PPG; DEFT water-based polyurethane 158.
 - 5) Vermont Natural Coatings; PolyWhey Natural Furniture Finish.
 - e. Sand Between Urethane Coats: 220 grit sandpaper.
4. Interior Metals (Not specified to receive other coating systems/not shop finished), Acrylic Paint Finish:
 - a. One Coat: Approved primer, in shop under other Sections (where specified). If not shop primed, provide primer recommended by finish coating manufacturer.
 - 1) Moore; Ultra Spec HP Acrylic Metal Primer HP04.
 - b. And Two Coats:
 - 1) Moore; Ultra Spec 500 Interior Latex Semi-Gloss T546.
 - 2) PPG; Speedhide Zero VOC Interior Latex Semi-Gloss 6-4510XI.
 - 3) S-W; ProMar 200 HP Zero VOC Interior Semi-Gloss.

5. Interior Exposed Steel, Joists, Ductwork, Conduit and Similar Items (where indicated), Waterborne Dry-Fall or Dry-Fog Painted System:
 - a. One Coat:
 - 1) Moore; Latex Dry Fall Flat 395 at 2.5 to 3.0 mils DFT.
 - 2) PPG; Speedhide Super Tech WB Interior Dry-Fog Latex 6-725XI Flat at 2.0 to 2.5 mils DFT.
 - 3) S-W; WB Pro Industrial Waterborne Acrylic Dryfall Flat B42 series at 2.5 to 3.0 mils DFT.
 - 4) Tnemec 115 WB Unibond DF at 2.5 to 3.0 mils DFT.
 - D. Mechanical and Electrical Work: Paint all exposed items throughout the project except factory finished items with factory-applied baked enamel finishes which occur in mechanical rooms or areas, and excepting chrome or nickel plating, stainless steel, and aluminum other than mill finished. Paint all exposed ductwork and inner portion of all ductwork. Same as specified for other interior metals, hereinabove.

END OF SECTION

SECTION 101100
VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Markerboards.
 - 2. Tackboards.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 064020 - INTERIOR ARCHITECTURAL WOODWORK for custom wood trim for visual display surfaces.
 - 2. Section 099000 - PAINTING AND COATING for primers under marker wall covering.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each type of visual display surface indicated, for units with factory-applied color finishes, and as follows:
 - 1. Actual sections of visual display surfaces.
 - 2. Fabric swatches fabric-faced tack assemblies.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show location of panel joints.
 - 2. Show location of special-purpose graphics for visual display surfaces.
 - 3. Include sections of typical trim members.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of fabrics.
- E. Maintenance Data: For visual display surfaces to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of visual display surface through one source from a single manufacturer.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-built visual display boards, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site.
- B. Store visual display units vertically with packing materials between each unit.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating visual display surfaces without field measurements. Coordinate wall construction to ensure that actual dimensions correspond to established dimensions.
 - 2. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

PART 2 - PRODUCTS

2.1 BASIS-OF-DESIGN

- A. Basis-of-Design Products: Refer to the Finish Schedule on the Drawings.

2.2 MARKERBOARD ASSEMBLIES

- A. Glass Markerboards: 6-mm tempered glass markerboard, with smooth polished edge and eased corners; color coated on back surface.
 - 1. Clear Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering.
 - 2. Mounting: Round, stainless-steel standoffs, holding glass approximately 1 inch from wall surface; mounted in notches in standoffs at top and bottom edges of markerboard.
 - 3. Magnetic backing.
 - 4. Color and Surface: As selected by the Architect.

5. Marker Tray: Glass, supported by stainless-steel clips.

2.3 TACKBOARD ASSEMBLIES

A. Fabric-Wrapped Tackboard:

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. Claridge Products & Equipment, Inc.
 - b. Egan Visual Inc.
 - c. MooreCo; Best-Rite Manufacturing.
 - d. Peter Pepper Products.
 - e. Steelcase Company.
2. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard backing with binder containing no added urea formaldehyde.
3. Fire Rating: ASTM E 84, Class A.
4. Fabric Facing Material, Colors and Patterns: Refer to Finish Schedule.

2.4 ACCESSORIES

- ### A. Adhesive: Mildew-resistant, nonstaining adhesive, for use with specific tackable visual display surfaces and substrate application, as recommended in writing by visual display surface manufacturer.

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

2.5 FABRICATION

- ### A. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.

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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove dirt, scaling paint, projections, and depressions that will affect smooth, finished surfaces of visual display boards.

- B. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, and substances that will impair bond between visual display boards and surfaces.

3.3 INSTALLATION

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

- 1. Join adjacent wall panels with concealed steel splines for smooth alignment.

3.4 CLEANING AND PROTECTION

- A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION

SECTION 101400

SIGNAGE

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Code-required interior panel signage, including but not limited to, accessibility signage, toilet room signage and mechanical and electrical room signage.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Division 26 - ELECTRICAL for illuminated exit signs.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of sign.
- B. Shop Drawings: Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.
 - 1. Provide message list for each sign, including large-scale details of wording, lettering, artwork, and braille layout.
- C. Samples for Verification: For each type of sign, include the following Samples to verify color selected:
 - 1. Panel Signs: Full-size Samples of each type of sign required.
 - 2. Approved samples will not be returned for installation into Project.
- D. Maintenance Data: For signage cleaning and maintenance requirements to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each sign type through one source from a single manufacturer.

- B. Regulatory Requirements: Comply with the Massachusetts Architectural Access Board, Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Where sizes of signs are determined by dimensions of surfaces on which they are installed, verify dimensions by field measurement before fabrication and indicate measurements on Shop Drawings.

1.6 COORDINATION

- A. For signs supported by or anchored to permanent construction, advise installers of anchorage devices about specific requirements for placement of anchorage devices and similar items to be used for attaching signs.

PART 2 - PRODUCTS

2.1 PANEL SIGNS

- A. General: Provide signs that comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction as indicated. Produce smooth panel sign surfaces constructed to remain flat under installed conditions within tolerance of plus or minus 1/16 inch measured diagonally. Provide the following:

- 1. Code-Required Signs for Certificate of Occupancy:

- a. Type: Photopolymer on acrylic or printed acrylic / aluminum as applicable.
- b. Color: Selected from manufacturer's standard colors including metallic silver, off white, champagne, light gray, dark red, dark green, dark blue, dark bronze, charcoal.
- c. Color: Custom color as selected.
- d. Type Size: As selected.
- e. Typeface: As selected.

- 2. Interior Signs Based on Owner's Requirements:

- a. Type: Photopolymer on acrylic or printed acrylic as applicable.
- b. Color: Selected from manufacturer's standard colors including metallic silver, off white, champagne, light gray, dark red, dark green, dark blue, dark bronze, charcoal.
- c. Color: Custom color as selected.
- d. Type Size: As selected.
- e. Typeface: As selected.

- 3. Exterior Signs:

- a. Type: As indicated on the Drawings.
- b. Type – Entrance: Fabricated [monolithic] [curved panel] aluminum sign with [masked and painted] [dimensional] [stencil cut] graphics and [non-] [internally] illuminated.

- b. Type – Wall: Fabricated aluminum panel with [masked and painted] [dimensional] [stencil cut] graphics and [non-] [halo] [internally] illuminated.
 - c. Type – Wall: Fabricated [aluminum] [stainless steel] [painted] letters and [non-] [halo] [internally] illuminated.
 - d. Type – Directional: Fabricated aluminum sign, 3 inches deep, double post and panel, vinyl graphics.
 - e. Type – Regulatory: Single 18 by 12 by 0.125 inches painted aluminum panel on a 2 inch square aluminum post, vinyl graphics.
4. Specialty Signs:
- a. Type: Custom as indicated on the Drawings.
- B. Tactile and Braille Copy: Manufacturer's standard process for producing copy complying with ADA Accessibility Guidelines and ICC/ANSI A117.1. Text shall be accompanied by Grade 2 braille. Produce precisely formed characters with square cut edges free from burrs and cut marks.
- 1. Raised-Copy Thickness: Not less than 1/32 inch
- C. Symbols of Accessibility: Provide 6-inch- high symbol fabricated from opaque nonreflective vinyl film, 0.0035-inch nominal thickness, with pressure-sensitive adhesive backing suitable for both exterior and interior applications.

2.2 ACCESSORIES

- A. Mounting Methods: Use double-sided vinyl tape fabricated from materials that are not corrosive to sign material and mounting surface.
- B. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Verify that items provided under other sections of Work are sized and located to accommodate signs.
- C. Examine supporting members to ensure that surfaces are at elevations indicated or required to comply with authorities having jurisdiction and are free from dirt and other deleterious matter.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Locate signs and accessories where indicated, using mounting methods of types described and in compliance with manufacturer's written instructions.
 - 1. Install signs level, plumb, and at heights indicated, with sign surfaces free from distortion and other defects in appearance.
 - 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.

- B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using methods indicated below:
 - 1. Vinyl-Tape Mounting: Use double-sided foam tape to mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.

3.3 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by the Architect.

END OF SECTION

SECTION 102800
TOILET ACCESSORIES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Toilet accessories as scheduled on the Drawings. Coordinate with Owner for accessories provided by Owner.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 061000 - ROUGH CARPENTRY for blocking.
 - 2. Section 064020 - INTERIOR ARCHITECTURAL WOODWORK for field applied wood frame at mirror.
 - 3. Section 088000 - GLAZING for adhered mirrors to receive field applied wood trim.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
 - 5. Manufacturer's warranty.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated on Drawings.
 - 2. Identify products using designations indicated on Drawings.
- C. Maintenance Data: For toilet accessories to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.

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.

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. A & J Washroom Accessories, Inc.
 - 2. American Specialties, Inc.
 - 3. Bobrick Washroom Equipment, Inc.
 - 4. Bradley Corporation.

2.2 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.
- B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch (0.9-mm) minimum nominal thickness.
- C. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- D. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

2.3 FABRICATION

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

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

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

END OF SECTION

SECTION 104400
FIRE-PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Portable fire extinguishers.
 - 2. Mounting brackets for fire extinguishers.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 099000 - PAINTING AND COATING for field painting fire-protection cabinets.
 - 2. Division 21 - FIRE PROTECTION for fire hose valves and standpipes.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each item.
 - 1. Fire Extinguishers: Include rating and classification.
- B. Maintenance Data: For fire extinguishers and fire-protection cabinets to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire extinguishers and fire-protection cabinets through one source from a single manufacturer.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1.5 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

PART 2 - PRODUCTS

2.1 PORTABLE FIRE EXTINGUISHERS

- A. General: Provide fire extinguishers of type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
- B. 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.

2.2 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

2.3 FINISHES, GENERAL

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.
- B. Examine fire extinguishers for proper charging and tagging. Contractor shall be responsible for fire extinguisher tagging by a certified service technician located within 75 miles of the project.
 - 1. Remove and replace damaged, defective, or undercharged units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire-protection specialties in locations and at mounting heights indicated on the Drawings and acceptable to authorities having jurisdiction.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

3.3 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection specialties are installed, unless otherwise indicated in manufacturer's written installation instructions.

END OF SECTION

SECTION 105110

METAL LOCKERS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Metal duty wardrobe / equipment lockers with bench tops.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 061000 - ROUGH CARPENTRY for furring, blocking, and shims required for installing metal lockers and concealed within other construction before metal locker installation.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker and bench.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show base, top, trim and other accessories.
 - 2. Include locker identification system.
- C. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative of metal locker manufacturer for installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain metal lockers and accessories through one source from a single manufacturer.
- C. Regulatory Requirements: Where metal lockers are indicated to comply with accessibility requirements, comply with Massachusetts Architectural Access Board requirements and the

U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for metal locker installation.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify the following by field measurements before fabrication and indicate measurements on Shop Drawings:
 - 1. Concealed framing, blocking, and reinforcements that support metal lockers before they are enclosed.
 - 2. Recessed openings.
 - 3. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish recessed opening dimensions and proceed with fabricating metal lockers without field measurements. Coordinate wall and floor construction to ensure that actual recessed opening dimensions correspond to established dimensions.

1.7 COORDINATION

- A. Coordinate size and location of bases for metal lockers.
- 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.

PART 2 - PRODUCTS

2.1 ALL-WELDED, METAL DUTY LOCKERS

- A. Available Manufacturers:
 - 1. Lyon Workspace Products; All-Welded Valor Law Enforcement Lockers.
 - 2. Penco Products, Inc., Subsidiary of Vesper Corporation; All-Welded Duty Lockers with drawer base.
 - 3. Spacesaver All welded Freestyle Personal Storage Lockers.
- B. Locker Arrangement: Single tier with drawer base and continuous hard wood butcher block seat as indicated.
- C. Body: Assembled by welding body components together. Fabricate from unperforated, cold-rolled steel sheet with thicknesses as follows:
 - 1. Tops, Bottoms, and Sides: 0.0528 inch thick.
 - 2. Backs: 0.0428 inch thick.

3. Shelves: 0.0528 inch thick, with double bend at front and single bend at sides and back.
- D. Frames: Channel formed; fabricated from 0.0528-inch-thick, cold-rolled steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.
- E. Locker Base: Structural channels, formed from 0.0528-inch-thick, cold-rolled steel sheet; welded to front and rear of side-panel frames.
- F. Doors: One-piece; fabricated from 0.0677-inch-thick, cold-rolled steel sheet; formed into channel shape with double bend at vertical edges, and with right-angle single bend at horizontal edges.
 1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches (381 mm) wide; welded to inner face of doors.
 2. Door Style: Louvered vents.
- G. Hinges: Self-closing; welded to door and attached to door frame with not less than 2 factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
- H. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry resistant.
- I. Equipment: Equip each metal locker with identification plate and the following, unless otherwise indicated:
 1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
- J. Accessories:
 1. Continuous Sloping Tops: Fabricated from minimum 0.0428-inch-thick, cold-rolled steel sheet; approximately 20-degree pitch.
 2. Recess Trim: Fabricated from 0.0428-inch-thick, cold-rolled steel sheet.
 3. Filler Panels: Fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet.
 4. Boxed End Panels: Fabricated from 0.0528-inch-thick, cold-rolled steel sheet.
- K. Finish: Baked enamel or powder coat, color as selected.

2.2 LOCKER BENCH TOPS

- A. General: Provide locker benches fabricated by same manufacturer as metal lockers.
- B. Bench Tops: Manufacturer's standard 1-piece units, of the following material, minimum 9-1/2 inches wide by 1-1/4 inches thick, with rounded corners and edges:
 1. Laminated maple with one coat of clear sealer on all surfaces, and one coat of clear lacquer on top and sides.

2.3 FABRICATION

- A. General: Fabricate metal lockers square, rigid, and without warp; with metal faces flat and free of dents or distortion. Make exposed metal edges free of sharp edges and burrs, and safe to touch.
 - 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 a complete installation.
- B. Unit Principle: Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.
- C. All-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 flush.
- D. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.
- E. Coat Rods: Fabricated from steel; nickel plated.
- F. Identification Plates: Manufacturer's standard etched, embossed, or stamped aluminum plates; with numbers and letters at least 3/8 inch (9 mm) high.
- G. Continuous Sloping Tops: Fabricated in lengths as long as practicable, without visible fasteners at splice locations; finished to match lockers.
 - 1. Sloped top corner fillers, mitered.
- H. Recess Trim: Fabricated with minimum 2-1/2-inch (64-mm) face width and in lengths as long as practicable; finished to match lockers.
- I. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip joint filler angle formed to receive filler panel.
- J. Boxed End Panels: Fabricated with 1-inch- (25-mm-) 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.
- K. Finished End Panels: Designed for concealing 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.
- L. Center Dividers: Full-depth, vertical partitions between bottom and shelf; finished to match lockers.

2.4 STEEL SHEET FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.
- C. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond. Use manufacturer's standard methods.
- D. Powder-Coat Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard baked-polymer thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install 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. Install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion, using concealed fasteners.
 - 2. Anchor single rows of metal lockers to walls near top of lockers and to floor.
 - 3. Anchor back-to-back metal lockers to floor.
- B. All-Welded Metal Lockers: Connect groups of all-welded metal lockers together with standard fasteners, with no exposed fasteners on face frames.
- C. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
- D. Locker Bench Tops: Provide continuous bench tops set on drawer base units. Securely fasten to undersides of bench tops.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.
- B. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit metal locker use during construction.

- C. 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 metal locker manufacturer.

END OF SECTION

SECTION 122400

SHADES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Roller shades with manual shade operators.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 061000 - ROUGH CARPENTRY for wood blocking and grounds for mounting roller shades and accessories.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.
- B. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Ceiling suspension system members and attachment to building structure.
 - 2. Ceiling-mounted or penetrating items including light fixtures, air outlets and inlets, speakers, sprinklers, recessed shades, and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.
 - 3. Shade mounting assembly and attachment.
 - 4. Size and location of access to shade operator and adjustable components.
 - 5. Minimum Drawing Scale: 1/4 inch = 1 foot.
- D. Samples for Initial Selection: For each colored component of each type of shade indicated.
 - 1. Include similar Samples of accessories involving color selection.

- E. Samples for Verification:
 - 1. Complete, full-size operating unit not less than 16 inches wide for each type of roller shade indicated.
 - 2. For the following products:
 - a. Shade Material: Not less than 12-inch- square section of fabric, from dye lot used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of material.
 - b. Valance: Full-size unit, not less than 12 inches long.
- F. Window Treatment Schedule: For roller shades. Use same designations indicated on Drawings.
- G. Product Certificates: For each type of roller shade, signed by product manufacturer.
- H. Qualification Data: For Installer.
- I. Product Test Reports: For each type of roller shade.
- J. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining roller shades and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
 - 3. Operating hardware.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Source Limitations: Obtain roller shades through one source from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. Flame-Resistance Ratings: Passes NFPA 701.
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

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. Rollers Shades: Before installation begins, for each size, color, texture, and pattern indicated, full-size units equal to 5 percent of amount installed.

PART 2 - PRODUCTS

2.1 BASIS-OF-DESIGN

- A. Basis-of-Design Products: Refer to the Schedule on the Drawings.

2.2 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Draper Inc.
 - 2. Hunter Douglas Contract; Nysan Shading Systems.
 - 3. MechoShade Systems, Inc.

2.3 ROLLER SHADES

- A. Shadecloth: Transparent (1% or greater), 100% polyester or PLA biopolymer fabric, PVC-free.
 - 1. Fire-Test-Response Characteristics: Passes NFPA 701, with no chemical flame retardants.
 - 2. Building Product Disclosure and Optimization, Material Ingredients: Cradle to Cradle (C2C) Gold certification.
 - 3. Low-Emitting Materials: Provide adhesives and sealants in compliance with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - 4. Bottom Hem: Straight.
 - 5. Colors: To be selected by Architect from manufacturer's full range.

- B. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with removable spline fitting integral channel in tube for attaching shade material.
 - 1. Direction of Roll: Regular, from back of roller
- C. Mounting Brackets: Galvanized or zinc-plated steel.
- D. Fascia: L-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; continuous panel concealing front and bottom of shade roller, brackets, and operating hardware and operators; length as indicated on Drawings removable design for access.
- E. Top/Back Cover: L-shaped; material and finish to match fascia; combining with fascia and end caps to form a six-sided headbox enclosure sized to fit shade roller and operating hardware inside.
- F. Pocket-Style Headbox: U-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; with a bottom cover consisting of slot opening of minimum dimension to allow lowering and raising of shade and a removable or an openable, continuous metal access panel concealing shade roller, brackets, and operating hardware and operators within.
- G. Bottom Bar: Steel or extruded aluminum. Provide concealed, by pocket of shade material, internal-type bottom bar with concealed weight bar as required for smooth, properly balanced shade operation.
- H. Mounting: As indicated on Drawings, mounting permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.
- I. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard for anchoring roller shade bottom in place and keeping shade band material taut.

2.4 ROLLER SHADE FABRICATION

- A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.
- B. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.
 - 1. Lifting Mechanism: With permanently lubricated moving parts.
- C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F:
 - 1. Shade Units Installed between (Inside) Jambs: Edge of shade not more than 1/4 inch from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.
 - 2. Shade Units Installed Outside Jambs: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

- D. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting fascia, roller, and operating hardware and for hardware position and shade mounting method indicated.
- E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.
- F. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

2.5 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

- A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
 - 1. Bead Chains: Manufacturer's standard.
 - a. Loop Length: Full length of roller shade.
 - b. Limit Stops: Provide upper and lower ball stops.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions, and located so shade band is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION

SECTION 129000
BUILDING SPECIALTIES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Flat panel Articulated TV Mounts.
 - 2. Boot Dryer.
 - 3. Lateral File Cabinets
- B. Alternates: Not Applicable.
- C. Items To Be Installed Only: Not Applicable.
- D. Items To Be Furnished Only: Not Applicable.
- E. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
 - 1. Section 061000 - ROUGH CARPENTRY for blocking.
 - 2. Section 260001 - ELECTRICAL WORK for services and connections.

1.3 SUBMITTALS

- A. Product Data: Include for each product specified.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain products through one source from a single manufacturer.

1.5 COORDINATION

- A. Coordinate size and location of blocking and mounting details with installation of building specialties.

PART 2 - PRODUCTS

2.1 FLAT PANEL TV WALL MOUNTS

- A. Basis of Design, Swingout Mount: Premier Mounts; Model AM300-B, Monoprice, Star Tech, or approved equal.
 - 1. As scheduled.
 - 2. Supported Screen Size: 40 to 68 inches Flat Panel Displays.
 - 3. Capacity: Up to 300 lb (136 kg).
 - 4. Extension: 4 to 26 inches from the wall surface.
 - 5. Finish: Manufacturer's standard black paint.

2.2 BOOT DRYER

- A. Basis of Design: Alpine Dryers, Gear Dryers, Heater Craft Cyclone or approved equal..
 - 1. As scheduled.
 - 2. Boot Capacity: 8 pairs.
 - 3. Mounting: Wall.
 - 4. Material^o Aluminum, Powder coated finish.
 - 5. Power: 110/120 VAC 0.8 to 12.1 amps.
 - 6. Timed drying cycles.

2.3 LATERAL FILE CABINETS

- A. Basis of Design: Great Openings; TRACE #RG A C301, HON Flagship, Allsteel or approved equal.
 - 1. As scheduled.
 - 2. Coordinate with Section 064020 - INTERIOR ARCHITECTURAL WOODWORK for counter top and blocking.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. TV Mount: Install mounts according to manufacturer's written instructions, and located so swingout is unobstructed by adjacent materials, and adjust moving or operating parts to function smoothly.
 - 1. Use wedge anchoring devices securely fastened plumb and square to masonry walls.
- B. Boot Dryers: Install mounts according to manufacturer's written instructions.

3.3 CLEANING AND PROTECTION

- A. Protect installed products until completion of project and touch-up, repair or replace damaged products before Substantial Completion.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train User Agency's maintenance personnel to adjust, operate, and maintain hanging garment conveyor.

END OF SECTION

SECTION 220000

GENERAL

PART 1 - GENERAL

1.1 FILING OF SUB-BIDS

- A. Sub-bids for work under this Section shall be for the complete work and shall be filed in with the Awarding Authority at a time and method stipulated in the Bidding Requirements.
- B. All sub-bids shall be submitted on the Form for Sub-Bid furnished by the Awarding Authority, as required in Section 44F of Chapter 149 of the Massachusetts General Laws, as amended.
- C. Specific information relating to sub-bidders is set forth in the Bidding and Contract Documents and the Sub-bidders are directed thereto.
- D. Sub-bids filed with the Awarding Authority shall be accompanied by a Bid Bond issued by a responsible bank or trust company payable to the Town of Sharon in the amount of five percent of the Bid. A sub-bid accompanied by any other form of bid depository will be rejected.
- E. Work to be done under this Section is shown on the Drawings: P001, P100
- F. Project Phasing specified in Section 011401 is part of the Work of
- G. The listing of Contract Drawings above shall not limit the Subcontractors responsibility to determine the full extent of his work as required by all Contract Drawings.
- H. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- I. Examine all other Sections of the Specifications for requirements, which affect work under this Section whether or not such work is specifically mentioned in this Section.
- J. Sub Sub-Bid Requirements: (None required under this Section.)

1.2 GENERAL PROVISIONS

- A. Applicable provisions of "General Conditions" govern work under this section.
- B. The Mechanical Contractor shall review all other sections of these Specifications for requirements therein affecting the work of this Section.
- C. The Mechanical Contractor shall conform to all sections of these Specifications and Drawings.
- D. Contractor's duties for work specified below shall include compliance with all local and National Codes, Ordinances, Rules, Regulations, Orders, and all other requirements of Authorities, which bear on the performance of work.

SHARON WATER BUILDING
SHARON, MA

KSID, LLC
SEPTEMBER 1, 2023

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

SECTION 220523.12

BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Section Includes:
 - 1. Brass ball valves.
 - 2. Bronze ball valves.
 - 3. Steel ball valves.
 - 4. Iron ball valves.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
 - 1. Certification that products comply with NSF 61 Annex G and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, and soldered ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.
- 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 operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.5 for flanges on steel valves.
 - 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 5. ASME B16.18 for solder-joint connections.
 - 6. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.

- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
 - 2. Handlever: For quarter-turn valves smaller than NPS 4.
- H. Valves in Insulated Piping:
 - 1. Include 2-inch stem extensions.
 - 2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
 - 3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRASS BALL VALVES

- A. Three-Piece, Brass Ball Valves with Full Port and Brass Trim:
 - 1. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Three piece.
 - d. Body Material: Forged brass.
 - e. Ends: Threaded and soldered.
 - f. Seats: PTFE.
 - g. Stem: Brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Full.

2.3 BRONZE BALL VALVES

A. Three-Piece, Bronze Ball Valves with Full Port and Bronze or Brass Trim:

1. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Three piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE.
 - g. Stem: Bronze or brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Full.

2.4 STEEL BALL VALVES

A. Class 150, Steel Ball Valves with Full Port:

1. Description:
 - a. Standard: MSS SP-72.
 - b. CWP Rating: 285 psig.
 - c. Body Design: Split body.
 - d. Body Material: Carbon steel, ASTM A 216, Type WCB.
 - e. Ends: Flanged or threaded.
 - f. Seats: PTFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel, vented.
 - i. Port: Full.

2.5 IRON BALL VALVES

A. Class 125, Iron Ball Valves:

1. Description:
 - a. Standard: MSS SP-72.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Split body.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Ends: Flanged or threaded.
 - f. Seats: PTFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel.
 - i. Port: Full.

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 valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For 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.

3.4 DOMESTIC HOT- AND COLD-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. Three-piece, brass ball valves with full port and brass trim.
 - 3. Three-piece, bronze ball valves with full port and bronze or brass trim.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. Class 150, steel ball valves with full port.
 - 3. Class 150, iron ball valves.

END OF SECTION

SECTION 220523.14

CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Section Includes:
 - 1. Bronze lift check valves.
 - 2. Bronze swing check valves.
 - 3. Iron swing check valves.
 - 4. Iron swing check valves with closure control.
 - 5. Iron, grooved-end swing check valves.
 - 6. Iron, center-guided check valves.
 - 7. Iron, plate-type check valves.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
 - 1. Certification that products comply with NSF 61 Annex G and NSF 372.

1.5 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 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. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

4. ASME B16.18 for solder joint.
 5. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
 - D. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.
 - E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
 - F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
 - G. Valve Sizes: Same as upstream piping unless otherwise indicated.
 - H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE LIFT CHECK VALVES

- A. Class 125, Lift Check Valves with Bronze Disc:
 1. 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 or soldered. See valve schedule articles.
 - f. Disc: Bronze.
- B. Class 125, Lift Check Valves with Nonmetallic Disc:
 1. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded or soldered. See valve schedule articles.
 - f. Disc: NBR, PTFE.

2.3 BRONZE SWING CHECK VALVES

A. Class 125, Bronze, Swing Check Valves with Bronze Disc:

1. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 200 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded or soldered. See valve schedule articles.
- f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Description:

- a. Standard: MSS SP-80, Type 4.
- b. CWP Rating: 200 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded or soldered. See valve schedule articles.
- f. Disc: PTFE.

C. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. 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 or soldered. See valve schedule articles.
- f. Disc: Bronze.

D. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:

1. Description:

- a. Standard: MSS SP-80, Type 4.
- b. CWP Rating: 300 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded or soldered. See valve schedule articles.
- f. Disc: PTFE.

2.4 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged or threaded. See valve schedule articles.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.

B. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:

1. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged or threaded. See valve schedule articles.
- f. Trim: Composition.
- g. Seat Ring: Bronze.
- h. Disc Holder: Bronze.
- i. Disc: PTFE.
- j. Gasket: Asbestos free.

2.5 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:

1. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged or threaded. See valve schedule articles.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.
- h. Closure Control: Factory-installed exterior lever and weight.

2.6 IRON, CENTER-GUIDED, SPRING-LOADED CHECK VALVES

A. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron.
- d. Style: Compact wafer, spring loaded.
- e. Seat: Bronze.

B. Class 125, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron.
- d. Style: Globe, spring loaded.
- e. Ends: Flanged.
- f. Seat: Bronze.

C. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

1. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron.
- d. Style: Compact wafer, spring loaded.
- e. Seat: EPDM or NBR.

D. Class 125, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

1. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron.
- d. Style: Globe, spring loaded.
- e. Ends: Flanged.
- f. Seat: EPDM or NBR.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.
- F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

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. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or spring; or iron, center-guided, metal-seat or resilient-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 CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- C. End Connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded.
 - 6. For Steel Piping, NPS 5 and Larger: Flanged.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller: Bronze swing check valves, Class 125, bronze disc with soldered or threaded end connections.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron swing check valves, Class 125, metal seats with threaded or flanged end connections.
 - 2. Iron swing check valves with closure control, Class 125, lever and spring with threaded or flanged end connections.
 - 3. Iron, grooved-end swing check valves, 300 CWP.
 - 4. Iron, center-guided check valves, Class 125, compact wafer.
 - 5. Iron, center-guided check valves, Class 125, globe, metal seat with threaded or flanged end connections.
 - 6. Iron, dual-plate check valves, Class 125 seat with threaded or flanged end connections.

7. Iron, single-plate check valves, Class 125, resilient seat with threaded or flanged end connections.

END OF SECTION

SECTION 220523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

A. Section Includes:

- 1. Bronze ball valves.
- 2. Lubricated plug valves.
- 3. Brass butterfly valves.

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: Non-rising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.

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 B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service, and shall meet the low-lead requirements of NSF-372.

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, grooved ends, and weld ends.
 - 3. Set ball and plug valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
 - 1. Maintain valve-end protection.
 - 2. Store valves indoors and maintain at higher than ambient dewpoint temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

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. Handwheel: For valves other than quarter-turn types.
 - 2. Hand lever: For quarter-turn valves NPS 6 and smaller except plug valves.
 - 3. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 lug valves, for each size square plug-valve head.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
- 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 BRONZE BALL VALVES

A. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Nibco Inc.
 - d. Or owner, architect and engineer approved equal.
2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 400 psig.
 - c. Body Design: One piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Bronze.
 - h. Ball: Chrome-plated brass.
 - i. Port: Reduced.

2.3 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nordstrom Valves, Inc.
 - b. Or owner, architect and engineer approved equal.
2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication sealing system.
 - d. Pattern: Regular or short.
 - e. Plug: Cast iron or bronze with sealant groove.

B. Class 125, Cylindrical, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
 - d. Or owner, architect and engineer approved equal.

2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication sealing system.
 - d. Pattern: Regular or short.
 - e. Plug: Cast iron or bronze with sealant groove.

2.4 BUTTERFLY VALVES

A. 300-psig, Brass Butterfly Valves with Grooved Ends:

1. Manufacturers: Victaulic Company; Series 608N.
2. Description:
 - a. CWP Rating: 300 psig.
 - b. Body Material: Brass casting per UNS C87850.
 - c. Ends: Copper-tube dimensioned grooved ends. (Flaring the adjoining pipe or fitting ends to accommodate alternate sized couplings is not permitted.)
 - d. Disc: Aluminum-bronze per UNS C95500.
 - e. Seat: Pressure-responsive grade CHP fluoroelastomer.
 - f. Stem: Stainless steel. Stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating.
 - g. UL classified in accordance with ANSI / NSF-61 for potable water service, and shall be certified to the low lead requirements of NSF-372.

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 grooved ends for form and cleanliness. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
- 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.

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 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Ball Valves: One piece, full port, brass with brass trim.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Ball Valves: One piece, full port, brass with brass trim.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Brass Valves: Copper-tube dimensioned grooved ends, pressure-responsive seat.

END OF SECTION

SECTION 220529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
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: 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. Equipment supports.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 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. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. 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 copper-coated steel.
- C. Stainless-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.2 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 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

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. 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.
 - h. Or owner, architect and engineer approved equal.
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 carbon steel.

B. Non-MFMA Manufacturer Metal Framing Systems:

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; a subsidiary of Mueller Water Products Inc.
 - b. Empire Industries, Inc.
 - c. ERICO International Corporation.
 - d. Haydon Corporation; H-Strut Division.
 - e. NIBCO INC.
 - f. PHD Manufacturing, Inc.

- g. PHS Industries, Inc.
 - h. Or owner, architect and engineer approved equal.
- 2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
 - 3. Standard: Comply with 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 carbon steel.
 - 7. Coating: Zinc.

2.4 THERMAL-HANGER SHIELD INSERTS

- 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. 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.
 - 10. Or owner, architect and engineer approved equal.
- 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.

2.5 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, zinc-coated 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.

2.6 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 plastic 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: Plastic.
 - 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.

2.7 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.

2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.9 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. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use

- operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. 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.
- G. 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.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. 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.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. 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.
- M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. 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.
- O. 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 pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

- F. Use stainless-steel pipe hangers and fiberglass pipe hangers and fiberglass strut systems and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of 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.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. 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.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 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.

- M. 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.
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- Q. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 220533

HEAT TRACING FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Section includes plumbing piping heat tracing for freeze prevention, domestic hot-water-temperature maintenance, and snow and ice melting on roofs and in gutters and downspouts with the following electric heating cables:
 - 1. Self-regulating, parallel resistance.
- B. Related Requirements:
 - 1. Section 210533 "Heat Tracing for Fire-Suppression Piping."
 - 2. Section 230533 "Heat Tracing for HVAC Piping."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
 - 2. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
- B. Shop Drawings: For electric heating cable.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
 1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

- A. Comply with IEEE 515.1.
- B. Heating Element: Pair of parallel No. 16 AWG, tinned or nickel-coated, stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.

- C. Electrical Insulating Jacket: Flame-retardant polyolefin.
- D. Cable Cover: Tinned-copper or Stainless-steel braid and polyolefin outer jacket with ultraviolet inhibitor.
- E. Maximum Operating Temperature (Power On): 150 deg F.
- F. Maximum Exposure Temperature (Power Off): 185 deg F.
- G. 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.
- H. Capacities and Characteristics:
 - 1. Maximum Heat Output: 5 W/ft. for all piping
 - 2. Electrical Characteristics for Single-Circuit Connection:
 - a. Volts: 277.
 - b. Phase: Single.
 - c. Hertz: 60.
 - 3. All heat tracing cable shall be connected to centralized control system and BAS.
 - 4. Main heat tracing panel with built in 277V power distribution circuit shall be provided.

2.2 CONTROLS

- A. Pipe-Mounted Thermostats for Freeze Protection:
 - 1. Remote bulb unit with adjustable temperature range from 30 to 50 deg F.
 - 2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
 - 3. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
 - 4. Corrosion-resistant, waterproof control enclosure.

2.3 ACCESSORIES

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
- B. Warning Labels: Refer to Section 220553 "Identification for Plumbing Piping and Equipment."
- C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
 - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Install the following types of electric heating cable for the applications described:
 - 1. Freeze Production: Self-regulating, parallel-resistance heating cable.

3.3 INSTALLATION

- A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.
- B. Electric Heating-Cable Installation for Freeze Protection for Piping:

1. Install electric heating cables after piping has been tested and before insulation is installed.
2. Install electric heating cables according to IEEE 515.1.
3. Install insulation over piping with electric cables according to Section 220719 "Plumbing Piping Insulation."
4. Install warning tape on piping insulation where piping is equipped with electric heating cables.
5. Set field-adjustable switches and circuit-breaker trip ranges.

3.4 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
 2. Test cables for electrical continuity and insulation integrity before energizing.
 3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- D. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.

- E. Cables will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

3.6 PROTECTION

- A. Protect installed heating cables, including nonheating leads, from damage during construction.
- B. Remove and replace damaged heat-tracing cables.

END OF SECTION 220533

SECTION 220548

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Section Includes:

- 1. Elastomeric isolation pads.
- 2. Elastomeric isolation mounts.
- 3. Restrained elastomeric isolation mounts.
- 4. Pipe-riser resilient supports.
- 5. Resilient pipe guides.
- 6. Elastomeric hangers.
- 7. Restraint channel bracings.
- 8. Restraint cables.
- 9. Seismic-restraint accessories.
- 10. Mechanical anchor bolts.
- 11. Adhesive anchor bolts.

- B. Related Requirements:

- 1. None.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:
 - 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.
- C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.
 - 1. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, due to seismic forces required to select vibration isolators, and due to seismic restraints.
 - 3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
 - 4. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

- c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
- d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For professional engineer.
- C. Welding certificates.
- D. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, 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 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: Per the Structural Engineer.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: I.
3. Seismic Parameters per the Structural Engineers requirements as found on the Structural drawings and other design related documents.
4. Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - a. 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 are subjected.

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:

1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
2. Size: Factory or field cut to match requirements of supported equipment.
3. Pad Material: Oil and water resistant with elastomeric properties.
4. Surface Pattern: Smooth pattern.
5. Infused nonwoven cotton or synthetic fibers.
6. Load-bearing metal plates adhered to pads.
7. Sandwich-Core Material: Resilient.

- a. Surface Pattern: Smooth pattern.
- b. Infused nonwoven cotton or synthetic fibers.

2.3 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:

1. Mounting Plates:

- a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
- b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

- 2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:

- 1. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - a. Housing: Cast-ductile iron or welded steel.
 - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.5 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.
 - 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 - 2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.6 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-thick neoprene.
 - 1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.7 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
 - 1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
 - 2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.8 RESTRAINT CHANNEL BRACINGS

- A. Description: MFMA-4, shop- or field-fabricated bracing 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; rated in tension, compression, and torsion forces.

2.9 RESTRAINT CABLES

- A. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.10 SEISMIC-RESTRAINT ACCESSORIES

- A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings.
- C. 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.
- D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.11 MECHANICAL ANCHOR BOLTS

- A. 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.

2.12 ADHESIVE ANCHOR BOLTS

- A. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless

steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- D. Equipment Restraints:
 - 1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.

2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

E. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

F. Install cables so they do not bend across edges of adjacent equipment or building structure.

G. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

I. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

J. 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.

K. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 221116 "Domestic Water Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Measure isolator restraint clearance.
 - 7. Measure isolator deflection.
 - 8. Verify snubber minimum clearances.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION

SECTION 220553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. 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 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.

2.2 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: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
 - 3. Valve-tag schedule shall be included in operation and maintenance data.

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 PIPE LABEL INSTALLATION

- A. 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.

- B. Pipe Label Color Schedule:

1. Domestic Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
2. Sanitary Waste, Storm Drainage and Forced Mains Piping and other piping types:
 - a. Background Color: Green.
 - b. Letter Color: White.

3.3 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and 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: 1-1/2 inches.
 - b. Hot Water: 1-1/2 inches.
 - c. Sanitary Waste, Storm, and Forced Mains: 1-1/2 inches.

 - 2. Valve-Tag Color:
 - a. Cold Water: Green.
 - b. Hot Water: Green.
 - c. Sanitary Waste, Storm, and Forced Mains: Green.

 - 3. Letter Color:
 - a. Cold Water: White.
 - b. Hot Water: White.
 - c. Sanitary Waste, Storm, and Forced Mains: White.

END OF SECTION

SECTION 220719

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Plumbing piping requiring insulation:
 - 1. Domestic Hot, Cold, and Recirc piping
 - 2. Piping Where Heat Tracing Is Installed

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 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.

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. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.
- C. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

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 sizes and locations 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. 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 "Piping Insulation Schedule, General" and "Indoor Piping Insulation 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, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pittsburgh Corning Corporation; Foamglas.
 - b. Or owner, architect and engineer approved equal.
 - 2. Block Insulation: ASTM C 552, Type I.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.

4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
5. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - f. Or owner, architect and engineer approved equal.
2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.
 - b. Or owner, architect and engineer approved equal.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.
 - b. Or owner, architect and engineer approved equal.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.
 - b. Or owner, architect and engineer approved equal.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F (minus 73 to plus 93 deg C).
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.
 - b. Or owner, architect and engineer approved equal.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Or owner, architect and engineer approved equal.
 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.
 - b. Or owner, architect and engineer approved equal.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. P.I.C. Plastics, Inc.
 - d. Or owner, architect and engineer approved equal.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Foster Brand; H. B. Fuller Construction Products.
 - b. Knauf Insulation.
 - c. Or owner, architect and engineer approved equal.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Or owner, architect and engineer approved equal.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
 3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Or owner, architect and engineer approved equal.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Knauf Insulation.
 - e. Mon-Eco Industries, Inc.
 - f. Or owner, architect and engineer approved equal.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: 60 percent by volume and 66 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. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Or owner, architect and engineer approved equal.
 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
 4. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
 5. Color: White.

2.6 SEALANTS

- A. Joint Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
 - e. Or owner, architect and engineer approved equal.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Permanently flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
 5. Color: White or gray.
 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. FSK and Metal Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Or owner, architect and engineer approved equal.
 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 (Minus 40 to plus 121 deg C).
 5. Color: Aluminum.
 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.
 - b. Or owner, architect and engineer approved equal.
 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 (Minus 40 to plus 121 deg C).
 5. Color: White.
 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
 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. McGuire Manufacturing.
 - b. Plumberex.
 - c. Truebro; a brand of IPS Corporation.
 - d. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
 - e. Or owner, architect and engineer approved equal.
 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.9 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. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.
 - b. Or owner, architect and engineer approved equal.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. PVC jackets are available in several colors. Colored jackets may be used to replace field painting. UV rays fade colors in exterior applications. Some colors (black, gray, and

white) do not fade as quickly as other colors (red, orange, and green). Colored jackets have different emissivity and are not recommended for outdoor use.

4. Color: White.
5. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Metal Jacket: (For Parking Structural Only)

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.
 - b. Or owner, architect and engineer approved equal.
2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Among the three moisture barriers in first subparagraph below, 1-mil (0.025-mm) barrier provides the least protection against galvanic corrosion, 3-mil (0.075-mm) barrier offers better protection, and polysurlyn barrier offers the best protection. For most indoor applications, 1-mil (0.025-mm) barrier is adequate. For outdoor applications, select either 3-mil (0.075-mm) or polysurlyn barrier.
 - d. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
 - e. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
 - f. 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.
3. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.10 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Compac Corporation.
 - c. Ideal Tape Co., Inc., an American Biltrite Company.
 - d. Knauf Insulation.
 - e. Or owner, architect and engineer approved equal.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Compac Corporation.
 - b. Ideal Tape Co., Inc., an American Biltrite Company.
 - c. Or owner, architect and engineer approved equal.
 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.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Compac Corporation.
 - c. Ideal Tape Co., Inc., an American Biltrite Company.
 - d. Knauf Insulation.
 - e. Or owner, architect and engineer approved equal.
 2. Width: 2 inches.
 3. Thickness: 3.7 mils.
 4. Adhesion: 100 ounces force/inch in width.

5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.11 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ITW Insulation Systems; Illinois Tool Works, Inc.
 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.
 - b. Or owner, architect and engineer approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
- B. 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 piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Cleanouts.
- 3.4 PENETRATIONS
- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. 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" for firestopping and fire-resistive joint sealers.

C. 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 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. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

- 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. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe 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.

C. 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.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

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. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install 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.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. 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.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.
- 3.9 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 pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

- 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

- 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inch thick.

- b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - C. Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1/2 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
 - D. Piping Where Heat Tracing Is Installed:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 2 inches thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
- 3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE
- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
 - 1. If more than one material is listed, selection from materials listed is Contractor's option.
 - B. Piping, Exposed:
 - 1. PVC: 20 mils 30 mils thick.
 - 2. Aluminum, Smooth Corrugated 0.016 inch thick.
 - a. Painted, Aluminum Smooth or corrugated 0.016 inch (0.41mm) thick.

END OF SECTION

SECTION 221116
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Section Includes:
 - 1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 - 2. Specialty valves.
 - 3. Flexible connectors.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Grooved joint products shall be shown on drawings and product submittals and shall be specifically identified with the applicable Victaulic style or series number.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 and NSF 372 for potable domestic water piping and components.
- C. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- D. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

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.

- B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L, (ASTM B 88M, Type B), ASTM B 88, Type M (ASTM B 88M, Type C) water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) ASTM B 88, Type L (ASTM B 88M, Type B) water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:
 - 1. MSS SP-123.
 - 2. Cast-copper-alloy, hexagonal-stock body.
 - 3. Ball-and-socket, metal-to-metal seating surfaces.
 - 4. Solder-joint or threaded ends.
- G. Copper Pressure-Seal-Joint Fittings:
 - 1. Elkhart Products Corporation; Industrial Division, Nibco Inc., Viega; Plumbing and Heating Systems.
 - 2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
 - 3. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
- H. Grooved Joint Fittings: ASME B16.18 cast bronze or ASME B16.22 wrought-copper; manufactured to copper-tube dimensions. (Flaring the adjoining pipe or fitting ends to accommodate alternate sized couplings is not permitted.)
 - 1. Basis of Design: Victaulic Copper-Connections.
- I. Grooved Joint Couplings: Grooved joint couplings shall consist of two ductile iron housing segments cast with offsetting, angle-pattern, bolt pads, pressure responsive elastomer gasket, and ASTM A49 zinc-electroplated steel bolts and nuts. Installation-Ready for direct stab installation without field disassembly.
 - 1. Basis of Design: Victaulic Style 607H.
 - 2. UL classified in accordance with ANSI / NSF-61 for potable water service, and shall be certified to the low lead requirements of NSF-372.
- J. Appurtenances for Grooved-End Copper Tubing:
 - 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.
 - b. Grinnell Mechanical Products.
 - c. Shurjoint Piping Products.
 - d. Victaulic Company.
 - e. Or owner, architect and engineer approved equal.
2. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.
 3. Mechanical Couplings for Grooved-End Copper Tubing:
 - a. Copper-tube dimensions and design similar to AWWA C606.
 - b. Ferrous housing sections.
 - c. EPDM-rubber gaskets suitable for hot and cold water.
 - d. Bolts and nuts.
 - e. Minimum Pressure Rating: 300 psig.

2.3 STAINLESS-STEEL PIPING

- A. Potable-water piping and components shall comply with NSF 61 Annex G.
- B. Stainless-Steel Pipe: ASTM A 312/A 312M, Schedule 10 and Schedule 40.
- C. Stainless-Steel Pipe Fittings: ASTM A 815/A 815M.
- D. Appurtenances for Grooved-End, Stainless-Steel Pipe:
 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. Shurjoint Piping Products.
 - b. Smith-Cooper International.
 - c. Star Pipe Products.
 - d. Victaulic Company.
 - e. Or owner, architect and engineer approved equal.
 2. Fittings for Grooved-End, Stainless-Steel Pipe: Stainless-steel casting with dimensions matching stainless-steel pipe.
 3. Mechanical Couplings for Grooved-End, Stainless-Steel Pipe:
 - a. AWWA C606 for stainless-steel-pipe dimensions.
 - b. Stainless-steel housing sections.
 - c. Stainless-steel bolts and nuts.
 - d. EPDM-rubber gaskets suitable for hot and cold water.
 - e. Minimum Pressure Rating:
 - 1) NPS 8 and Smaller: 600 psig.
 - 2) NPS 10 and NPS 12: 400 psig.
 - 3) NPS 14 to NPS 24: 250 psig.

2.4 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
- C. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- E. 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.
- F. Copper Pressure-Seal-Joint 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. Elkhart Products Corporation; Industrial Division.
 - b. NIBCO INC.
 - c. Viega; Plumbing and Heating Systems.
 - d. Or owner, architect and engineer approved equal.

2.5 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
 - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Grooved Joint Lubricants: Lubricate gaskets with lubricant supplied by the coupling manufacturer in accordance with published installation instructions. The lubricant shall be approved for the gasket elastomer and system media.

2.6 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.

2.7 TRANSITION FITTINGS

- A. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- B. Sleeve-Type Transition Coupling: AWWA C219.

2.8 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. Description:
 - a. Pressure Rating: 150 psig at 180 deg F.
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Waterway: Copper silicon casting conforming to UNS C87850 with grooved and/or threaded ends. UL classified in accordance with NSF-61 for potable water service, and shall meet the low-lead requirements of NSF-372.
 - 1. Basis of Design: Victaulic Series 647.
- D. Dielectric Nipples:
 - 1. Description:
 - a. Electroplated steel nipple.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Male threaded or grooved.
 - d. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved 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/A21.5.
- 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 for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with

requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

- 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 piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- J. 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.
- K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- L. Install piping adjacent to equipment and specialties to allow service and maintenance.
- M. Install piping to permit valve servicing.
- N. 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.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- R. 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.
- S. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.
- T. Install thermometers on outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- U. 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."
- V. 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."

- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze 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. Grooved Joints: Install in accordance with the manufacturer's latest published installation instructions. Pipe ends shall be clean and free from indentations, projects and roll marks in the area from pipe end to (and including) groove. Gasket shall be manufactured by the coupling manufacturer and verified as suitable for the intended service.
 - 1. A factory trained representative (direct employee) of the coupling manufacturer shall provide on-site training for the contractor's field personnel in the use of grooving tools, application of groove, and product installation. The representative shall periodically visit the job site and review the installation to ensure best practices in grooved joint installation are being followed. Contractor shall remove and replace any improperly installed products.
- G. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- H. Copper-Tubing, Push-on Joints: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- I. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- J. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Roll groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

- K. 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.
- L. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in 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.

3.4 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Vibration 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.

3. 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.
 - F. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 1. NPS 6: 10 feet with 5/8-inch rod.
 2. NPS 8: 10 feet with 3/4-inch rod.
 - G. Install supports for vertical copper tubing every 10 feet.
 - H. 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.
 - I. Install supports for vertical steel piping every 15 feet.
 - J. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.
 - K. Install hangers for stainless-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.
 - L. Install supports for vertical stainless-steel piping every 15 feet.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
 - 3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.7 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.

3.8 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.

3.9 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 hot-water flow 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.

B. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

A. Clean and disinfect 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.
 - C. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
 - D. Prepare and submit reports of purging and disinfecting activities. Report shall certify "The total absence of coliform bacteria". Two tests shall be taken on the hot and cold water piping from the farthest end of each floor. (4 water samples for each floor).
 - E. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
- 3.11 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. Under-building-slab, Trap Priming piping, NPS 1/2, shall be one of the following:
 1. Soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A), wrought-copper, solder-joint fittings; and brazed joints.

- D. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and soldered joints.
 2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) copper pressure-sealjoint fittings; and pressure-sealed joints.
 3. Hard copper tube, ASTM B 88 Type L (ASTM B 88M, Type B) copper push-on-joint fittings; and push-on joints.
 4. Retain "one of" option in first paragraph below to allow Contractor to select piping materials from those retained.
- E. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and soldered joints.
 2. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper grooved-joint fittings; and installation-ready joints.
 3. Aboveground domestic water piping, NPS 5 to NPS 10, shall be one of the following:
 4. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) cast- or wrought-copper, solder-joint fittings; and soldered joints.
 5. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); grooved-joint, copper-tube appurtenances; and grooved joints.
 6. Stainless-steel Schedule 10 pipe, grooved-joint fittings, and grooved joints.
 7. Aboveground Trap Priming piping, NPS 1/2 shall be one of the following:
 8. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) cast-or wrought-copper, solder-joint fittings; and soldered joints.
 9. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) copper pressure-seal-joint fittings; and pressure-sealed joints.
 10. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) copper push-on-joint fittings; and push-on joints.
 11. Aboveground domestic water piping, (For Pressure Above 80 PSI.) NPS 5 to NPS 10, shall be the followings:
 - a. Stainless-steel Schedule 10 pipe, grooved-joint fittings, and grooved joints.

3.12 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: 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

SECTION 221119

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

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. Hose bibbs.
8. Wall hydrants.
9. Drain valves.
10. Water hammer arresters.
11. Trap-seal primer valves.
12. Trap-seal Primer System.
13. Water Meters.

- B. Related Sections include the following:

1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Division 22 Section "Domestic Water Piping" for water meters.
3. Division 22 Section "Domestic Water Filtration Equipment" for water filters in domestic water piping.
4. Division 22 Section "Emergency Plumbing Fixtures" for water tempering equipment.
5. Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

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. 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. Ames Co.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. FEBCO; SPX Valves & Controls.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
 - g. Or owner, architect and engineer approved equal.
 - 2. Standard: ASSE 1001.
 - 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
 - 4. Body: Bronze.
 - 5. Inlet and Outlet Connections: Threaded.
 - 6. Finish: Rough bronze.
- B. Hose-Connection Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. MIFAB, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Woodford Manufacturing Company.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
 - g. Zurn Plumbing Products Group; Wilkins Div.
 - h. Or owner, architect and engineer approved equal.
2. Standard: ASSE 1011.
 3. Body: Bronze, nonremovable, with manual drain.
 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 5. Finish: Chrome or nickel plated.

2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
 - g. Or owner, architect and engineer approved equal.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Size: 2"
6. 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.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight through flow.
9. 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. Hose-Connection Backflow Preventers:

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. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Woodford Manufacturing Company.

- d. Or owner, architect and engineer approved equal.
 2. Standard: ASSE 1052.
 3. Operation: Up to 10-foot head of water back pressure.
 4. Inlet Size: NPS 1/2 or NPS 3/4.
 5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
 6. Capacity: At least 3-gpm flow.
- C. Backflow-Preventer Test Kits:
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. 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.
 - f. Or owner, architect and engineer approved equal.
 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Bermad.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Honeywell Water Controls.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
 - g. Or owner, architect and engineer approved equal.
 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.

2.4 BALANCING VALVES

- A. Copper-Alloy Calibrated Balancing 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. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Industries; Bell & Gossett Div.
 - d. NIBCO INC.
 - e. TAC Americas.
 - f. Taco, Inc.
 - g. Victaulic Company.
 - h. Watts Industries, Inc.; Water Products Div.
 - i. Or owner, architect and engineer approved equal.
2. Type: DZR Brass (Ametal®) globe type ball valve with two readout ports and memory setting indicator.
3. Body: DZR 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. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

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. Leonard Valve Company.
 - b. Powers; a Watts Industries Co.
 - c. Symmons Industries, Inc.
 - d. Taco, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
 - g. Or owner, architect and engineer approved equal.
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 union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Finish: Chrome plated.

B. Primary, Thermostatic, Water Mixing 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. Armstrong International, Inc.

- b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Powers; a Watts Industries Co.
 - e. Symmons Industries, Inc.
 - f. Or owner, architect and engineer approved equal.
2. Standard: ASSE 1017.
 3. Pressure Rating: 125 psig.
 4. Type: Exposed-mounting, thermostatically controlled water mixing valve.
 5. Material: Bronze body with corrosion-resistant interior components.
 6. Connections: Threaded union inlets and outlet.
 7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 8. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
 9. Valve Finish: Rough bronze.
 10. Piping Finish: Copper.
 11. Cabinet: Factory-fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.

C. Individual-Fixture, Water Tempering 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. 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.
 - i. Or owner, architect and engineer approved equal.
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.

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. Strainers NPS 2 and Smaller: 0.020 inch.

- b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
 - c. Strainers NPS 5 and Larger: 0.10 inch.
6. Drain: Pipe plug.

2.7 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 or field-installation, 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.
- 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.

2.8 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

- 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. Josam Company.
 - b. MIFAB, Inc.
 - c. Prier Products, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Woodford Manufacturing Company.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
 - j. Or owner, architect and engineer approved equal.
- 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: Rough bronze.
12. Operating Keys(s): One with each wall hydrant.

2.9 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

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. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. PPP Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products Inc.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
 - j. Or owner, architect and engineer approved equal.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.10 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer 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. MIFAB, Inc.
 - b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Or owner, architect and engineer approved equal.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.11 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

1. Precision Plumbing Product, Zurn Industries.
2. Standard: ASSE 1044.
3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
4. Cabinet: Recessed or Surface-mounted steel box with stainless-steel cover.
5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
 - 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.
6. Vacuum Breaker: ASSE 1001.
7. Number Outlets: Refer to Drawings.
8. Size Outlets: NPS 1/2.

2.12 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Flex Pression Ltd.
2. Flex-Hose Co., Inc.
3. Flexicraft Industries.
4. Flex-Weld, Inc.
5. Hyspan Precision Products, Inc.
6. Mercer Gasket & Shim, Inc.
7. Metraflex Company (The).
8. Proco Products, Inc.
9. Tozen Corporation.
10. Unaflex.
11. Universal Metal Hose.
12. Or owner, architect and engineer approved equal.

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.

2.13 WATER METERS

A. Displacement-Type Water Meters:

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. AALIANI.
 - b. ABB.
 - c. Carlson Meter.
 - d. Mueller Co.
 - e. Schlumberger Limited.
 - f. Sensus.
 - g. Or owner, architect and engineer approved equal.
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 company.
 - e. Case: Bronze.
3. End Connections: Threaded.

B. Compound-Type Water Meters:

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. ABB.
 - b. Badger Industries, Inc.
 - c. Master Meter, Inc.
 - d. Mueller Co.
 - e. Schlumberger Limited.
 - f. Sensus.
 - g. Or owner, architect and engineer approved equal.
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.

C. 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.

1. 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 INSTALLATION

- A. 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.
- B. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- C. Install balancing valves in locations where they can easily be adjusted.
- D. 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.
- E. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve and pump.
- F. Install water hammer arresters in water piping according to PDI-WH 201.
- G. 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.
- H. 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. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

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. Intermediate atmospheric-vent backflow preventers.
 - 3. Reduced-pressure-principle backflow preventers.
 - 4. Double-check, backflow-prevention assemblies.
 - 5. Dual-check-valve 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. Hose stations.
 - 12. Supply-type, trap-seal primer valves.
 - 13. 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 Section 220553 "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 and reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.

- B. Set field-adjustable flow set points of balancing valves.

- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

SECTION 221123
FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

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.

1.4 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
 - 2. Service Regulators: 65 psig minimum unless otherwise indicated.
 - 3. Minimum Operating Pressure of Service Meter: 30 psig.
- B. Natural-Gas System Pressure within Buildings: 2 psig or less.
- C. Natural Gas system Pressure for Flare: 17 psig.

1.5 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Piping specialties.
 - 2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.

3. Pressure regulators. Indicate pressure ratings and capacities.
4. Service meters. Indicate pressure ratings and capacities. Include meter bars supports.
5. Dielectric fittings.

B. Welding certificates.

C. Field quality-control reports.

D. Operation and Maintenance Data: For pressure regulators 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 Owner no fewer than two days in advance of proposed interruption of natural-gas service.

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.

2.2 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.

2.3 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. 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.
 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.
 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. 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.

2.4 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. Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.
- B. Comply with NFPA 54 requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 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 "Utility Earthwork" 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.

3.4 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. 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. 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.
- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. 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.
- P. 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 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.
3. 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.

- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- R. Connect branch piping from top or side of horizontal piping.
- S. 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.
- T. Do not use natural-gas piping as grounding electrode.
- U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- V. 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."
- W. 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."
- X. 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 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

3.6 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

F. 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.

3.7 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.

D. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:

1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod size, 3/8 inch.

3.8 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. 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.
- E. 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.

3.10 PAINTING

- A. Comply with requirements in Division 09 painting Section 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. Topcoat: Exterior alkyd enamel (flat).
 - c. Color: Gray.
- 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. Color: Gray.
- 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 NFPA 54 and authorities having jurisdiction.
 - C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
 - D. Prepare test and inspection reports.
- 3.12 OUTDOOR PIPING SCHEDULE
- A. Aboveground natural-gas piping shall be one of the following:
 1. Steel pipe with malleable-iron fittings and threaded joints.
 2. Steel pipe with wrought-steel fittings and welded joints.
- 3.13 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG
- A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:
 1. Steel pipe with malleable-iron fittings and threaded joints.
 - B. Aboveground, distribution piping shall be one of the following:
 1. Steel pipe with malleable-iron fittings and threaded joints.
 2. Steel pipe with wrought steel fittings and welded joints.
- 3.14 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE
- A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
 1. Bronze plug valve.
 - B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:
 1. Cast-iron, nonlubricated plug valve.
 - C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
 1. Bronze plug valve.
 - D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:
 1. Cast-iron, lubricated plug valve.
 - E. Valves in branch piping for single appliance shall be one of the following:
 1. Bronze plug valve.

END OF SECTION

SECTION 221316

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.
 - 3. Encasement for underground metal piping.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class(es).
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
 - 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. Fernco Inc.
 - b. MIFAB, Inc.
 - c. Mission Rubber Company; a division of MCP Industries, Inc.
 - d. Tyler Pipe.
 - e. Or owner, architect and engineer approved equal.
 - 2. Standards: ASTM C 1277 and CISPI 310.
 - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

- A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight class. Include square-cut-grooved or threaded ends matching joining method.
- B. Galvanized-Cast-Iron Drainage Fittings: ASME B16.12, threaded.
- C. Steel Pipe Pressure Fittings:
 - 1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
 - 2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
 - 3. Galvanized-Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.

D. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:

1. Galvanized, Grooved-End Fittings for Galvanized-Steel Piping: ASTM A 536 ductile-iron castings, ASTM A 47/A 47M malleable-iron castings, ASTM A 234/A 234M forged steel fittings, or ASTM A 106/A 106M steel pipes with dimensions matching ASTM A 53/A 53M steel pipe, and complying with AWWA C606 for grooved ends.
2. Grooved Mechanical Couplings for Galvanized-Steel Piping: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber gasket suitable for hot and cold water; and bolts and nuts.

2.5 DUCTILE-IRON PIPE AND FITTINGS

A. Ductile-Iron, Mechanical-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, mechanical-joint, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Ductile-Iron, Push-on-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, push-on-joint ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.

C. Gaskets: AWWA C111/A21.11, rubber.

2.6 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

- C. Hard Copper Tube: ASTM B 88, Type L and Type M, water tube, drawn temper.
- D. Copper Pressure Fittings:
 - 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- E. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.
- F. Dielectric Fittings:
 - 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
 - 2. Dielectric Unions:
 - 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) A.Y. McDonald Mfg. Co.
 - 2) Capitol Manufacturing Company.
 - 3) Central Plastics Company.
 - 4) HART Industrial Unions, LLC.
 - 5) Jomar Valve.
 - 6) Matco-Norca.
 - 7) Watts; a Watts Water Technologies company.
 - 8) Wilkins.
 - 9) Zurn Industries, LLC.
 - 10) Or owner, architect and engineer approved equal.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 125 psig minimum at 180 deg F.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
 - 3. Dielectric Flanges:

- 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) Capitol Manufacturing Company.
 - 2) Central Plastics Company.
 - 3) Matco-Norca.
 - 4) Watts; a Watts Water Technologies company.
 - 5) Wilkins.
 - 6) Zurn Industries, LLC.
 - 7) Or owner, architect and engineer approved equal.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: 125 psig minimum at 180 deg F.
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
4. Dielectric-Flange Insulating Kits:
- a. Ion:
 - 1) Nonconducting materials for field assembly of companion flanges.
 - 2) Pressure Rating: 150 psig.
 - 3) Gasket: Neoprene or phenolic.
 - 4) Bolt Sleeves: Phenolic or polyethylene.
 - 5) Washers: Phenolic with steel backing washers.
5. Dielectric Nipples:
- 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) Elster Perfection Corporation.
 - 2) Grinnell Mechanical Products.
 - 3) Matco-Norca.
 - 4) Precision Plumbing Products.
 - 5) Victaulic Company.
 - 6) Or owner, architect and engineer approved equal.
 - b. Description:
 - 1) Standard: IAPMO PS 66
 - 2) Electroplated steel nipple.
 - 3) Pressure Rating: 300 psig at 225 deg F.
 - 4) End Connections: Male threaded or grooved.
 - 5) Lining: Inert and noncorrosive, propylene.

2.7 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A 674 or AWWA C105/A 21.5.
- B. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black or natural.

2.8 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
 - 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312010 "Utility Earthwork".

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. 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: 1 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

- M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- N. Install steel piping according to applicable plumbing code.
- O. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- P. Plumbing Specialties:
 - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Division 22 Section "Sanitary Waste Piping Specialties."
 - 2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
- 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 Section 220517 "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 Section 220517 "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 Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- 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 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.
- D. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- E. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Unshielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:
 - a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
 - b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.
2. Install gate or full-port ball valve for piping NPS 2 and smaller.
3. Install gate valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

3.6 HANGER AND SUPPORT INSTALLATION

A. All "in slab" sanitary and grease waste piping shall be fully supported along its entire length using MSS type 8 riser clamps secured to floor slab at 10 foot maximum intervals.

- B. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 3. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 4. Install 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.
 - 5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 6. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch 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 and NPS 8: 60 inches with 3/4-inch rod.
 - 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
 - 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for 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 and NPS 8: 12 feet with 3/4-inch rod.
 - 8. NPS 10 and NPS 12: 12 feet with 7/8-inch rod.
- I. Install supports for vertical steel piping every 15 feet.
- J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
3. NPS 2-1/2: 108 inches with 1/2-inch rod.
4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.
5. NPS 6: 10 feet with 5/8-inch rod.
6. NPS 8: 10 feet with 3/4-inch rod.

- K. Install supports for vertical copper tubing 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. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 5. Install horizontal backwater valves in pit with pit cover flush with floor.
 6. Comply with requirements for backwater valves cleanouts and drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
 7. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Connect force-main piping to the following:
1. Sanitary Sewer: To exterior force main.
 2. Sewage Pump: To sewage pump discharge.

- F. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- G. Make connections according to the following unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. 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.

3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 4. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- C. Aboveground, soil and waste piping NPS 5 and larger shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.

3. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- D. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 - a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.
 4. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- E. Aboveground, vent piping NPS 5 and larger shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 3. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- G. Underground, soil and waste piping NPS 5 and larger shall be any of the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- H. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 shall be any of the following:
1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
 2. Galvanized-steel pipe, pressure fittings, and threaded joints.
- I. Aboveground sanitary-sewage force mains NPS 2-1/2 to NPS 6 shall be[any of] the following:
1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
 2. Galvanized-steel pipe, pressure fittings, and threaded joints.
 3. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
- J. Underground sanitary-sewage force mains NPS 4 and smaller shall be any of the following:
1. Hard copper tube, Type L; wrought-copper pressure fittings; and soldered joints.
 2. Ductile-iron, mechanical-joint piping and mechanical joints.
 3. Ductile-iron, push-on-joint piping and push-on joints.
- K. Fitting-type transition coupling for piping smaller than NPS 1-1/2 and pressure transition coupling for NPS 1-1/2 and larger if dissimilar pipe materials.

END OF SECTION

SECTION 221319

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Cleanouts.
 - 2. Floor drains.
 - 3. Roof flashing assemblies.
 - 4. Through-penetration firestop assemblies.
 - 5. Miscellaneous sanitary drainage piping specialties.
 - 6. Flashing materials.

1.3 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.

1.4 COORDINATION

- A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. Josam Company; Blucher-Josam Div.
 - h. Or owner, architect and engineer approved equal.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
5. Closure: Countersunk or raised-head , 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.

B. Cast-Iron Wall Cleanouts:

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. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
 - f. Or owner, architect and engineer approved equal.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
5. Closure: Countersunk or raised-head, 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, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

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. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
 - h. Or owner, architect and engineer approved equal.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.

7. Clamping Device: Required.
8. Outlet: Bottom.
9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Not required.
11. Sediment Bucket: Required
12. Top or Strainer Material: Nickel bronze.
13. Top of Body and Strainer Finish: Nickel bronze.
14. Top Shape: Round.
15. Top Loading Classification: Light Duty.
16. Funnel: Not Required.

B. Cast-Iron Floor Drains:

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. Commercial Enameling Company.
 - b. Jay R. Smith Mfg. Co.
 - c. Josam Company.
 - d. MIFAB, Inc.
 - e. Prier Products, Inc.
 - f. Tyler Pipe; a subsidiary of McWane Inc.
 - g. Watts; a Watts Water Technologies company.
 - h. Zurn Industries, LLC.
 - i. Or owner, architect and engineer approved equal.
2. Standard: ASME A112.6.3.
3. Pattern: Area drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Not required.
11. Sediment Bucket: Required.
12. Top or Strainer Material: Gray iron.
13. Top Shape: Round.
14. Dimensions of Top or Strainer: 12 inch diameter, tractor grate.
15. Top Loading Classification: Heavy Duty.
16. Funnel: Where noted.
17. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
18. Trap Material: Cast iron.
19. Trap Pattern: Deep-seal P-trap.
20. Trap Features: Cleanout and trap-seal primer valve drain connection.

C. Cast-Iron Floor Drains:

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. Commercial Enameling Company.

- b. Jay R. Smith Mfg. Co.
 - c. Josam Company.
 - d. MIFAB, Inc.
 - e. Prier Products, Inc.
 - f. Tyler Pipe; a subsidiary of McWane Inc.
 - g. Watts; a Watts Water Technologies company.
 - h. Zurn Industries, LLC.
 - i. Or owner, architect and engineer approved equal.
2. Standard: ASME A112.6.3.
 3. Pattern: Floor Area drain.
 4. Body Material: Gray iron.
 5. Seepage Flange: Required.
 6. Anchor Flange: Required.
 7. Clamping Device: Required.
 8. Outlet: Bottom.
 9. Backwater Valve: Not required.
 10. Coating on Interior and Exposed Exterior Surfaces: Not required.
 11. Sediment Bucket: Required.
 12. Top or Strainer Material: Gray iron.
 13. Top Shape: Round.
 14. Dimensions of Top or Strainer: 12 inch diameter, tractor grate.
 15. Top Loading Classification: Heavy Duty.
 16. Funnel: Not required.
 17. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 18. Trap Material: Cast iron.
 19. Trap Pattern: Deep-seal P-trap.
 20. Trap Features: Cleanout and trap-seal primer valve drain connection.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing 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. Acorn Engineering Company.
 - b. Thaler Metal Industries Ltd.
 - c. Zurn Industries, LLC.
 - d. Or owner, architect and engineer approved equal.

2. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- thick, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - a. Open-Top Vent Cap: Without cap.
 - b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop 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. 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.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch- minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

B. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

C. 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.

2.6 FLASHING MATERIALS

- A. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
1. General Applications: 12 oz./sq. ft..
 2. Vent Pipe Flashing: 8 oz./sq. ft..
- B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- F. Solder: ASTM B 32, lead-free alloy.
- G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- E. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

- F. Install deep-seal traps on floor drains and other waste outlets.
- G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- H. Install air-gap fittings on draining-type backflow preventers.
- I. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- J. Install wood-blocking reinforcement for wall-mounting-type specialties.
- K. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- L. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- M. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- N. Install vent caps on each vent pipe passing through roof.
- O. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- P. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- Q. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 221429

SUMP PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submersible sump pumps.
2. Wet-pit-volute sump pumps.
3. Sump-pump basins and basin covers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Wiring Diagrams: For power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE SUMP PUMPS

A. Submersible, Fixed-Position, Single-Seal Sump Pumps:

1. Description: Factory-assembled and -tested sump-pump unit.
2. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
3. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
4. Impeller: Statically and dynamically balanced, design for clear wastewater handling, and keyed and secured to shaft.
5. Pump and Motor Shaft: Stainless steel or steel, with factory-sealed, grease-lubricated ball bearings.
6. Seal: Mechanical.
7. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
8. Controls:
 - a. Enclosure: NEMA 250, Type 1.
 - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches.
 - e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

9. Controls:
 - a. Enclosure: NEMA 250, Type 1 Wall-mounted.
 - b. Switch Type: Mechanical-float type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.

10. Control-Interface Features:
 - a. Remote Alarm Contacts: For remote alarm interface.
 - b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.

2.2 SUMP PUMP CAPACITIES AND CHARACTERISTICS

- A. Per the schedules.

2.3 SUMP-PUMP BASINS AND BASIN COVERS

- A. Basins: Factory-fabricated, watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.
 1. Material: Fiberglass.
 2. Reinforcement: Mounting plates for pumps, fittings, and accessories.

- B. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
 1. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.

C. Capacities and Characteristics:

1. Per the schedules

2.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Pump Installation Standard: Comply with HI 1.4 for installation of sump pumps.

END OF SECTION 221429

SECTION 223300

ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial, electric, domestic-water booster heaters.
2. Commercial, electric, storage, domestic-water heaters.
3. Commercial, light-duty, storage, electric, domestic-water heaters.
4. Residential, electric, storage, domestic-water heaters.
5. Thermostat-control, electric, tankless, domestic-water heaters.
6. Domestic-water heater accessories.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated.

- B. Shop Drawings:
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For commercial domestic-water heaters, accessories, and components, from manufacturer.
- B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex, "Drinking Water System Components - Health Effects."

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
1. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Electric, Domestic-Water Booster Heaters:
 - 1) Controls and Other Components: Five years.
 - b. Commercial, Electric, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: Five> years.
 - 2) Controls and Other Components: Five years.
 - c. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
 - 1) Storage Tank: Five> years.
 - 2) Controls and Other Components: Three years.
 - d. Residential, Electric, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: Ten years.
 - 2) Controls and Other Components: Three years.
 - e. Electric, Tankless, Domestic-Water Heaters: Five year(s).
 - f. Compression Tanks: Five years.

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

- A. Commercial, Electric, Domestic-Water Booster Heaters:
1. Standard: UL 1453.
 2. Tank Construction: Corrosion-resistant metal.
 - a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 Annex barrier materials for potable-water tank linings, including extending lining material into tappings.
 3. Factory-Installed Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.

- c. Insulation: Comply with ASHRAE/IESNA 90.1.
 - d. Jacket: Rectangular shaped, with stainless-steel front panel, unless otherwise indicated.
 - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
 - 1) Option: Booster heaters with total of 9 kW or less may have two or three elements.
 - f. Temperature Control: Adjustable thermostat, to setting of at least 180 deg F.
 - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
 - h. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valve. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
 - i. Gages: Combination temperature-and-pressure type or separate thermometer and pressure gage.
- B. Commercial, Electric, Storage, Domestic-Water Heaters:
- 1. Standard: UL 1453.
 - 2. Storage-Tank Construction: ASME-code (if over 120 Gallons in aggregate), steel vertical arrangement.
 - a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
 - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 Annex barrier materials for potable-water tank linings, including extending lining material into tappings.
 - 3. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - c. Insulation: Comply with ASHRAE/IESNA 90.1.
 - d. Jacket: Steel with enameled finish.
 - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
 - f. Temperature Control: Adjustable thermostat.
 - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
 - h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than

domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

4. Special Requirements: NSF 5 construction.
- C. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
1. Standard: UL 174.
 2. Storage-Tank Construction: Steel, vertical arrangement.
 - a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 Annex barrier materials for potable-water tank linings, including extending lining material into tappings.
 3. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2.
 - e. Jacket: Steel with enameled finish.
 - f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation unless otherwise indicated. Limited to 12 kW total.
 - h. Temperature Control: Adjustable thermostat.
 - i. Safety Control: High-temperature-limit cutoff device or system.
 - j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
- D. Capacity and Characteristics:
1. Per the Schedules

2.2 RESIDENTIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Residential, Electric, Storage, Domestic-Water Heaters:

1. Standard: UL 174.
2. Storage-Tank Construction: Steel.
 - a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 Annex barrier materials for potable-water tank linings, including extending lining material into tappings.
3. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: ASSE 1005.
 - d. Insulation: Comply with ASHRAE 90.2.
 - e. Jacket: Steel, cylindrical, with enameled finish.
 - f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - g. Heating Elements: Two; electric, screw-in immersion type; wired for nonsimultaneous operation unless otherwise indicated. Limited to 12 kW total.
 - h. Temperature Control: Adjustable thermostat.
 - i. Safety Control: High-temperature-limit cutoff device or system.
 - j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

B. Capacity and Characteristics:

1. Per the schedules.

2.3 ELECTRIC, TANKLESS, DOMESTIC-WATER HEATERS

A. Thermostat-Control, Electric, Tankless, Domestic-Water Heaters:

1. Standard: UL 499 for electric, tankless, (domestic-water heater) heating appliance.
2. Construction: Copper piping or tubing complying with NSF 61 Annex barrier materials for potable water, without storage capacity.
 - a. Connections: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Heating Element: Resistance heating system.
 - d. Temperature Control: Thermostat.

- e. Safety Control: High-temperature-limit cutoff device or system.
 - f. Jacket: Aluminum or steel with enameled finish or plastic.
- 3. Support: Bracket for wall mounting.
 - 4. Capacity and Characteristics:
 - a. Per the schedules

2.4 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:

- 1. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
- 2. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 Annex barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
- 3. Capacity and Characteristics:
 - a. Working-Pressure Rating: 150 psig.
 - b. Capacity Acceptable: Per the schedules.
 - c. Air Precharge Pressure: Per the schedules.

B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

D. Heat-Trap Fittings: ASHRAE 90.2.

- E. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig maximum outlet pressure unless otherwise indicated.
- F. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
- G. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.
- H. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- I. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- J. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.
- K. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.5 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases.
1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 2. Maintain manufacturer's recommended clearances.
 3. Arrange units so controls and devices that require servicing are accessible.
 4. 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 floor.
 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
 8. Anchor domestic-water heaters to substrate.
- B. Residential, Electric, Domestic-Water Heater Mounting: Install residential, electric, domestic-water heaters on floor.
1. Maintain manufacturer's recommended clearances.
 2. Arrange units so controls and devices that require servicing are accessible.
 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. Anchor domestic-water heaters to substrate.
- C. Electric, Tankless, Domestic-Water Heater Mounting: Install electric, tankless, domestic-water heaters at least 18 inches above floor on wall bracket.
1. Maintain manufacturer's recommended clearances.
 2. Arrange units so controls and devices that require servicing are accessible.
 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. Anchor domestic-water heaters to substrate.
- D. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."
- E. Install commercial, electric, domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- F. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- G. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- H. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
- I. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- J. Install pressure-reducing valve with integral bypass relief valve in electric, domestic-water booster-heater inlet piping and water hammer arrester in booster-heater outlet piping. Set pressure-reducing valve for outlet pressure of 35 psig. Comply with requirements for pressure-reducing valves and water hammer arresters specified in Section 221119 "Domestic Water Piping Specialties."
- K. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- L. Fill electric, domestic-water heaters with water.
- M. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

END OF SECTION 223300

SECTION 224100
RESIDENTIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bathtubs.
2. Faucets.
3. Lavatories.
4. Showers.
5. Kitchen sinks.
6. Laundry trays.
7. Dishwasher air-gap fittings.
8. Disposers.
9. Water closets.
10. Toilet seats.
11. Supply fittings.
12. Waste fittings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
- C. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted plumbing fixtures.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 BATHTUBS

- A. Bathtubs with shower.

- 1. Fixture:

- a. Standard: ASME A112.19.1/CSA B45.2 for enameled cast-iron or enameled-steel bathtubs.
- b. Standard: ANSI Z124.1.2 for FRP or PMMA bathtubs.
- c. Bathing Surface: Slip resistant according to ASTM F 462.
- d. Size: Per Schedule.
- e. Color: By Architect.
- f. Drain Location: per drawings
- g. Drain: chrome-plated-brass, pop-up waste and overflow.

- 2. Faucet: Per schedule.

- 3. Supply Fittings: Included in faucet.

- 4. Tub Filler: Chrome-plated-brass diverter spout.

- 5. Waste Fittings:

- a. Standard: ASME A112.18.2/CSA B45.125.2.
- b. Drain: Stainless steel or chrome-plated brass, removable strainer.
- c. Overflow: Chrome-plated-brass escutcheon with toggle drain-plug device.
- d. Drain Piping: cast-brass overflow, P-trap, and waste.

2.2 BATHTUB FAUCETS

- A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.
- B. Bathtub Faucets: Single handle, pressure balance or thermostatic.
 - 1. Standards: ASME A112.18.1/CSA B125.1 and ASSE 1016.
 - 2. Faucet:
 - a. Body Material: Solid brass.
 - b. Finish: Per the schedules.
 - c. Maximum Flow Rate: Per schedule.
 - d. Operation: Single handle control, with hot- and cold-water indicators.
 - e. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
 - f. Diverter: In-tub filler spout.
 - g. Supply Connections: NPS 1/2.
 - 3. Shower Head:
 - a. Standard: ASME A112.18.1/CSA B125.1.
 - b. Backflow-Prevention Device: ASSE 1014.
 - c. Shower Head Material: Per Schedules.
 - 4. Bathtub Filler Spout: Per Schedules.

2.3 LAVATORIES

- A. Lavatories: Oval, Rectangular, Round, enameled cast iron, enameled steel, PMMA, solid surface, stainless steel, vitreous china, or counter mounted.

1. Fixture:
 - a. Standard: ASME A112.19.1/CSA B45.2 for enameled cast-iron or -steel lavatories.
 - b. Standard: ANSI Z124.3 for PMMA lavatories.
 - c. Standard: ANSI Z124.3 and ANSI/ICPA SS-1 for solid-surface lavatories.
 - d. Standard: ASME A112.19.3/CSA B45.4 for stainless-steel lavatories.
 - e. Standard: ASME A112.19.2/CSA B45.1 for vitreous-china lavatories.
2. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
3. Waste Fittings: Comply with requirements in "Waste Fittings" Article.

2.4 LAVATORY FAUCETS

- A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.
- B. Lavatory Faucets
 1. Standard: ASME A112.18.1/CSA B125.1.
 2. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 3. Body Material: General-duty, solid brass.
 4. Finish: Per the schedules.
 5. Maximum Flow Rate: Per the schedules.

2.5 SHOWERS

- A. Showers: Standard FRP or PMMA with base and faucet.

1. Standard: ANSI Z124.1.2.
2. Nominal Size: Per the schedules.

B. Showers: Accessible FRP or PMMA with seat, grab bar, base, and faucet.

1. Standards: ANSI Z124.1.2 and ICC/ANSI A117.1 for roll-in shower compartments.
2. Nominal Size: Per the schedules.
3. Surround: One piece.
4. Accessibility Options: Include grab bar and bench.
5. Drain: Grid, NPS 2 (DN 50).

2.6 SHOWER FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.

B. Shower Faucets

1. Fixture:
 - a. Standard: ASME A112.18.1/CSA B125.1 and ASSE 1016.
 - b. General: Include hot- and cold-water indicators; check stops. Coordinate faucet inlets with supplies.
 - c. Finish: Per the schedules.
 - d. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
2. Supply Connections: NPS 1/2.
3. Shower Head:
 - a. Shower Head Material: Per the schedules.

2.7 KITCHEN SINKS

A. Kitchen Sinks.

1. Fixture:

- a. Standard: ASME A112.19.1/CSA B45.2 for enameled cast-iron or steel kitchen sinks.
 - b. Standard: ANSI Z124.3 for PMMA kitchen sinks.
 - c. Standard: ANSI Z124.3 and ANSI/ICPA SS-1 for solid-surface kitchen sinks.
 - d. Standard: ASME A112.19.3/CSA B45.4 for stainless-steel kitchen sinks.
 - e. Bowl:
 - 1) Dimensions: Per the schedules.
 - 2) Drain: 3-1/2-inch
2. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
 3. Waste Fittings: Comply with requirements in "Waste Fittings" Article, except include continuous waste for multibowl sinks.

2.8 LAUNDRY TRAYS

A. Laundry Trays: Plastic.

1. Fixture:

- a. Standard: IAPMO/ANSI Z124.6.
- b. Style: Flat-rim ledge.
- c. Material: Plastic.

- d. Mounting: Freestanding on manufacturer's standard legs or separate, painted-steel stand.
2. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
3. Waste Fittings: Comply with requirements in "Waste Fittings" Article.

2.9 SINK FAUCETS

- A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.
- B. Sink Faucets
 1. Standard: ASME A112.18.1/CSA B125.1.
 2. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 3. Kitchen Sink Option: Separate hand spray complying with ASSE 1025.
 4. Finish: Per the schedules.
 5. Maximum Flow Rate: Per the schedules.

2.10 DISHWASHER AIR-GAP FITTINGS

- A. Dishwasher Air-Gap Fittings:
 1. Standard: ASSE 1021.
 2. Description: Device designed to prevent backflow of contaminated liquid into domestic dishwashers.
 3. Material: Plastic body.
 4. Hose Connections: 5/8-inch ID inlet and 7/8-inch ID outlet.
 5. Capacity: At least 5 gpm; at inlet pressure of at least 5 psig and at temperature of at least 140 deg F.
 6. Mounting: Deck.
 7. Hoses: Rubber and suitable for temperature of at least 140 deg F.
 - a. Inlet Hose: 5/8 inch ID and 48 inches long.
 - b. Outlet Hose: 7/8 inch ID and 48 inches long.

2.11 DISPOSERS

- A. Disposers: Continuous-feed household, food waste.
 - 1. Standards: ASSE 1008 and UL 430, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. General: Include reset button; wall switch; corrosion-resistant chamber with jam-resistant, cutlery- or stainless-steel grinder or shredder; NPS 1-1/2 outlet; quick-mounting, stainless-steel sink flange; antisplash guard; and combination cover/stopper.
 - 3. Motor: 115 V ac, 1725 rpm, hp with overload protection.

2.12 WATER CLOSETS

- A. Water Closets: Floor mounted, floor outlet, close coupled (gravity tank), vitreous china.
 - 1. Bowl:
 - a. Standards: ASME A112.19.2/CSA B45.1, ASME A112.19.5, and ASSE 1037.
 - b. Rim Contour: Elongated.
 - c. Water Consumption: Per the Schedule.
 - 2. Supply Fittings:
 - a. Standard: ASME A112.18.1/CSA B125.1.
 - b. Supply Piping: Chrome-plated-brass pipe or chrome-plated-copper tube matching water-supply piping size. Include chrome-plated wall flange.
 - c. Stop: Chrome-plated-brass, one-quarter-turn, ball-type or compression stop with inlet connection matching water-supply piping type and size.
 - d. Riser:
 - 1) Size: NPS 1/2.
 - 2) Material: ASME A112.18.6, braided- or corrugated-stainless-steel flexible hose riser.
- B. Water Closets : Floor mounted, floor outlet, close coupled (flushometer tank), vitreous china.

1. Bowl:
 - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
 - b. Bowl Type: Siphon jet
 - c. Rim Contour: Elongated.
 - d. Water Consumption: Per the schedules.
2. Supply Fittings:
 - a. Standard: ASME A112.18.1/CSA B125.1.
 - b. Supply Piping: Chrome-plated-brass pipe or chrome-plated-copper tube matching water-supply piping size. Include chrome-plated wall flange.
 - c. Stop: Chrome-plated-brass, one-quarter-turn, ball-type or compression stop with inlet connection matching water-supply piping type and size.
 - d. Riser:
 - 1) Size: NPS 1/2.
 - 2) Material: ASME A112.18.6, braided- or corrugated-stainless-steel flexible hose riser.

2.13 TOILET SEATS

- A. Toilet Seats:
 1. Standard: IAPMO/ANSI Z124.5.
 2. Material: Plastic.
 3. Shape: Elongated rim (Open front)
 4. Size: Elongated.

2.14 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Lavatory, Kitchen Sink and Laundry Tray Supply Fittings:
 1. Supply Piping: Chrome-plated-brass pipe or chrome-plated-copper tube matching water-supply piping size. Include chrome-plated wall flange.

2. Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression stop with inlet connection matching water-supply piping type and size.
3. Risers:
 - a. Size: NPS 3/8 for lavatories.
 - b. Size: NPS 1/2 for kitchen sinks and laundry trays.
 - c. Material: ASME A112.18.6, braided- or corrugated-stainless-steel flexible hose riser.

2.15 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/4 offset tailpiece for accessible lavatories.
- C. Drain: Pop-up type with NPS 1-1/4 straight tailpiece as part of faucet for standard lavatories.
- D. Drain: Grid type with NPS 1-1/2 offset tailpiece for accessible kitchen sinks.
- E. Drain: Grid type with NPS 1-1/2 straight tailpiece for standard kitchen sinks and laundry trays.
- F. Trap:
 1. Size: NPS 1-1/2 for lavatories.
 2. Size: NPS 1-1/2 for kitchen sinks and laundry trays.
 3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

2.16 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 INSTALLATION

- A. Install plumbing fixtures level and plumb according to roughing-in drawings.

- B. Install floor-mounted water closets on closet flange attachments to drainage piping.
- C. Install counter-mounting fixtures in and attached to casework.
- D. Install pedestal lavatories on pedestals and secured to wood blocking in wall.
- E. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: Use ball or gate valves if supply stops are not specified with fixture. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
- F. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- G. Install toilet seats on water closets.
- H. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- I. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- J. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes unless otherwise indicated.
- K. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
- L. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Connect inlet hose to dishwasher and outlet hose to disposer.
- M. Set bathtubs and shower receptors in leveling bed of cement grout.
- N. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories and sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."
- O. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- P. Seal joints between plumbing fixtures, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.2 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories and sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 ADJUSTING

- A. Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

3.4 CLEANING AND PROTECTION

- A. After completing installation of plumbing fixtures, inspect and repair damaged finishes.
- B. Clean plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed plumbing fixtures and fittings.
- D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224100

SECTION 230000

GENERAL

PART 1 - GENERAL

1.1 FILING OF SUB-BIDS

- A. Sub-bids for work under this Section shall be for the complete work and shall be filed in with the Awarding Authority at a time and method stipulated in the Bidding Requirements.
- B. All sub-bids shall be submitted on the Form for Sub-Bid furnished by the Awarding Authority, as required in Section 44F of Chapter 149 of the Massachusetts General Laws, as amended.
- C. Specific information relating to sub-bidders is set forth in the Bidding and Contract Documents and the Sub-bidders are directed thereto.
- D. Sub-bids filed with the Awarding Authority shall be accompanied by a Bid Bond issued by a responsible bank or trust company payable to the Town of Sharon in the amount of five percent of the Bid. A sub-bid accompanied by any other form of bid depository will be rejected.
- E. Work to be done under this Section is shown on the Drawings: M001, M002, M100
- F. Project Phasing specified in Section 011401 is part of the Work of
- G. The listing of Contract Drawings above shall not limit the Subcontractors responsibility to determine the full extent of his work as required by all Contract Drawings.
- H. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- I. Examine all other Sections of the Specifications for requirements, which affect work under this Section whether or not such work is specifically mentioned in this Section.
- J. Sub Sub-Bid Requirements: (None required under this Section.)

1.2 GENERAL PROVISIONS

- A. Applicable provisions of "General Conditions" govern work under this section.
- B. The Mechanical Contractor shall review all other sections of these Specifications for requirements therein affecting the work of this Section.
- C. The Mechanical Contractor shall conform to all sections of these Specifications and Drawings.
- D. Contractor's duties for work specified below shall include compliance with all local and National Codes, Ordinances, Rules, Regulations, Orders, and all other requirements of Authorities, which bear on the performance of work.

SHARON WATER BUILDING
SHARON, MA

KSID, LLC
SEPTEMBER 1, 2023

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

SECTION 230517

SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.

1.3 ACTION 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 SLEEVE-SEAL SYSTEMS

- A. Subject to compliance with requirements, the following manufacturers are approved.
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. Metraflex Company (The).
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel or Stainless steel.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Subject to compliance with requirements, the following manufacturers are approved.
 - 1. Holdrite.

- 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.

2.4 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 Section 079200 "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 Section 078410 "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. 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.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

3.4 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 or Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves or Galvanized-steel-pipe sleeves.
 2. Exterior Concrete Walls below Grade:

- a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system or Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves with sleeve-seal system or Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs-on-Grade:
- a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system or Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves with sleeve-seal system or Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
- a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
 - 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

SECTION 230518
ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. The following manufacturers are approved for use.
 - 1. McGuire.
 - 2. Speakman.
 - 3. Chicago.
 - 4. American Standard.
- B. Provide with spring-catch fasteners at locations where piping, installed exposed to view, penetrates walls, partitions, floors and ceilings.

- C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- E. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- F. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.
- G. 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 with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening. Secure escutcheons to pipe or insulation and flush with the building surface.
 - 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 or split-casting brass type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - 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.
 - B. Escutcheons around stainless steel piping and in washdown areas shall be stainless steel.
 - 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.
- 3.2 FIELD QUALITY CONTROL
- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 230529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Pipe stands.
 - 7. Equipment 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.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Fiberglass strut systems.
 - 4. Pipe stands.
 - 5. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.7 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 APPROVED MANUFACTURERS

- A. All products:

1. Anvil International.
2. Bergen Power Pipe Supports.
3. Carpenter and Paterson.
4. National Pipe Hanger.
5. Cooper B-Line.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. 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 carbon steel.

B. 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 copper-coated steel.

2.3 TRAPEZE PIPE HANGERS

- ### A.
- Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
2. Standard: MFMA-4.
3. Channels: Continuous slotted steel channel with inturred lips.
4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

6. Metallic Coating: Electroplated zinc.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4.
3. Channels: Continuous slotted steel channel with inturred lips.
4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
6. Coating: Zinc.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. 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, zinc-coated 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 plastic 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: Plastic or 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.

2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.9 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. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. 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 Section 077200 "Roof Accessories" for curbs.
- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. 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.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- K. 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.
- L. Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. 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.
- N. 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 or ASME B31.1, as applicable.
 - 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.
- O. Support horizontal pipe runs using hangers and supports. Space hangers so that supported load does not exceed load recommended in writing by hanger manufacturer and maximum indicated support spacing. Do not impose pipe support loads that overstress building structural members.
 - P. Support riser piping independently from connected horizontal piping.
 - Q. Provide roller hangers for pipe supported on rod hangers where thermal movement will cause hanger rod to deviate more than 4 degrees from vertical, where longitudinal expansion will cause pipe movement of more than 1/2 inch in the piping, and where indicated.
 - R. Provide vertical adjustment at hangers for pipe 2 1/2 inches and larger.
 - S. Do not drill or burn holes in the structure without prior written approval of Design Professional. Do not provide power driven or drilled-in fasteners without written approval from Design Professional. Submit proposed locations and manufacturer's installation and design data for approval prior to drilling anchors. Location and types will be reviewed for compatibility with building structure systems only. Use a safety factor of 5 for selection of inserts and anchors.
 - T. Do not use pipe hooks, chains or perforated steel strap for pipe supports.
 - U. Do not support piping from ceiling supports, ductwork, equipment, electrical conduit, cable trays or other piping.
 - V. Provide hangers and supports not more than 12 inches from each face of horizontal elbow.
 - W. Use variable-support spring hangers where vertical movement from thermal expansion is between 1/4 inch and 2 inches.
 - X. Connect rooftop supports to building structure. Do not place supports on top of roofing material. Furnish rooftop pipe supports for installation before roofing is completed.
 - Y. For piping at grade, anchor supports to concrete, not earth.

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 and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM 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 pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of 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.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. 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.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 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.
- M. 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.
- N. 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.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

SECTION 230533

HEAT TRACING FOR HVAC PIPING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Section includes heat tracing for HVAC piping with the following electric heating cables:
 - 1. Plastic insulated, series resistance.
 - 2. Self-regulating, parallel resistance.
- B. Related Requirements:
 - 1. Section 210533 "Heat Tracing for Fire-Suppression Piping."
 - 2. Section 220533 "Heat Tracing for Plumbing Piping."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
 - 2. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
- B. Shop Drawings: For electric heating cable.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLASTIC-INSULATED, SERIES-RESISTANCE HEATING CABLES

- A. Approved Manufacturers:
 - 1. Raychem.
 - 2. Nelson.
 - 3. Delta-Therm.
- B. Comply with IEEE 515.1.
- C. Heating Element: Single- or dual-stranded resistor wire. Terminate with waterproof, factory-assembled, nonheating leads with connectors at both ends.
- D. Electrical Insulating Jacket: Minimum 4.0-mil Kapton with silicone, Tefzel, or polyolefin.
- E. Cable Cover: Aluminum braid and silicone
- F. Maximum Operating Temperature (Power On): 150 deg F.
- G. Maximum Exposure Temperature (Power Off): 185 deg F.
- H. 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 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

- A. Approved Manufacturers:
 - 1. Raychem.
 - 2. Nelson.
 - 3. Delta-Therm.

- B. Comply with IEEE 515.1.
- C. Heating Element: Pair of parallel No. 16 AWG, tinned or nickel-coated, stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.
- D. Electrical Insulating Jacket: Flame-retardant polyolefin.
- E. Cable Cover: Tinned-copper or stainless-steel braid.
- F. Maximum Operating Temperature (Power On): 150 deg F.
- G. Maximum Exposure Temperature (Power Off): 185 deg F.
- H. 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 Capacities and Characteristics:

- 1. Heat Output: 3 W/ft.
- 2. Electrical Characteristics for Single-Circuit Connection:
 - a. Volts: as required.
 - b. Phase: Single.
 - c. Hertz: 60.

2.4 CONTROLS

- A. Remote bulb unit with adjustable temperature range from 30 to 50 deg F.
- B. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
- C. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
- D. Corrosion-resistant, waterproof control enclosure.

2.5 ACCESSORIES

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
- B. Warning Labels: Refer to Section 230553 "Identification for HVAC Piping and Equipment."
- C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
 1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Install the following types of electric heating cable for the applications described:
 1. Freeze Production: Self-regulating, parallel-resistance heating cable.

3.3 INSTALLATION

- A. Install electric heating cable across expansion joints according to manufacturer's written instructions; use slack cable to allow movement without damage to cable.
- B. Install electric heating cables after piping has been tested and before insulation is installed.
- C. Install electric heating cables according to IEEE 515.1.
- D. Install insulation over piping with electric cables according to Section 230719 "HVAC Piping Insulation."
- E. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- F. Set field-adjustable switches and circuit-breaker trip ranges.

3.4 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

- A. Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections:
 - 1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
 - 2. Test cables for electrical continuity and insulation integrity before energizing.
 - 3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- C. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.
- D. Cables will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 PROTECTION

- A. Protect installed heating cables, including nonheating leads, from damage during construction.
- B. Remove and replace damaged heat-tracing cables.

END OF SECTION

SECTION 230548

VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. This Section includes the following:

- 1. Isolation pads.
- 2. Isolation mounts.
- 3. Freestanding spring isolators.
- 4. Housed spring mounts.
- 5. Elastomeric hangers.
- 6. Spring hangers.

1.3 DEFINITIONS

- A. IBC: International Building Code.

1.4 SUBMITTALS

- A. Product Data: For the following:

- 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

- B. Welding certificates.

- C. Qualification Data: For professional engineer.

- D. Field quality-control test reports.

- E. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products manufactured by one of the following.
 - 1. Amber/Booth Company, Inc.
 - 2. Isolation Technology, Inc.
 - 3. Kinetics Noise Control.
 - 4. Mason Industries.
 - 5. Vibration Eliminator Co., Inc.
 - 6. Vibration Isolation.
 - 7. 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. 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 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 500 psig.
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- E. Elastomeric Hangers: Double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
1. Basis of Design: Mason Industries: HD.

- F. Spring Hangers: Double-deflection type, combination coil-spring and elastomeric-insert hanger with spring and insert in compression and elastometric-insert element with projecting bushing.
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 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.
 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
 8. Basis of Design: Mason Industries: 30N.
- G. Travel-Limited Springs
1. Spring isolators shall be free-standing and laterally stable without any housing. Spring diameter shall be not less than 0.8 of compressed height of spring at design load. Spring shall have a minimum additional travel to solid equal to 50 percent of actual deflection and ratio of horizontal stiffness to vertical stiffness approximately 1. Mounts shall have leveling bolts and vertical travel limit stops to control extension when weight is removed. Travel limit stops shall be capable of serving as blocking during erection of equipment. Maintain a minimum clearance of 1/4 inch around restraining bolts and between limit stops and spring to avoid interference with spring action.
 2. Set spring element in isolator in a neoprene cup with a steel washer to distribute load evenly over neoprene, or mount each isolator on a unit DNP isolator. If DNP isolator is used, provide a rectangular bearing plate of sufficient size to load pad uniformly in range of 40 to 50 psi. If spring isolator is supplied with a neoprene friction pad, use a stainless steel, aluminum, or galvanized steel plate between friction pad and DNP isolator. Permanently adhere DNP isolator, separator plate, and friction pad to one another and to bottom of bearing plate.
 3. If isolator is to be fastened to building structure and a unit DNP isolator is used under bearing plate, provide neoprene washers and grommets for each bolt hole in base plate. Size bolt holes to allow for grommets. Hold-down bolt assembly shall include washers to distribute load evenly to grommet. Bolts and washers shall be galvanized.
 4. Approved Manufacturer: Mason Industries Type SLR.

2.2 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanized metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation devices to indicate capacity range.
- A. Concrete inertia bases shall be stone-aggregate concrete, 150 pounds per cubic foot, and appropriate steel reinforcing cast between perimeter structural steel channels. Inertia bases shall be a rigid base which will not twist, rack, deform, deflect, or crack in any manner which would negatively affect operation of supported equipment or vibration isolation mounts. Size to support equipment and motors plus any associated pipe elbow supports, duct elbow supports, electrical control elements, or other components closely related and requiring resilient support in order to prevent vibration transfer to building structure. Thickness shall be at least 1/12 longest dimension of inertia base with a minimum thickness of 6 inches but not more than 12 inches. Include side-mounting brackets for attachment to vibration isolators.
- B. Steel frame and reinforcement shall be supplied by vibration isolator manufacturer. Concrete: Division 03.
 - 1. Approved Manufacturer: Mason Industries Type KSL.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VIBRATION-CONTROL DEVICE INSTALLATION

- A. 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.

B. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

B. Remove and replace malfunctioning units and retest as specified above.

C. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust active height of spring isolators.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-mounting systems.
- B. Ductwork:
 - 1. All sheet metal ducts and air plenums that are within Mechanical Rooms or within 50 feet total duct length of connected vibration isolated equipment.
 - a. Isolator Type: Elastometric Hanger.
 - b. Minimum Deflection: 0.75 inches.

END OF SECTION

SECTION 230553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Valve tags.
 - 5. Warning tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- 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 and Steam Trap numbering scheme.
- E. Valve and Steam Trap Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass or aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. 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-quarters the size of principal lettering.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. 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), and 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) and 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, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

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-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or 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. Products of indicated manufacturers are acceptable.
 - 1. Seton Identification Products.
 - 2. Brady Corporation.
 - 3. Marking Services, Inc.
 - 4. Brimar Industries, Inc.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include 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: Size letters according to ASME A13.1 for piping.

2.4 VALVE TAGS

- A. Products of indicated manufacturers are acceptable.
 - 1. Seton Identification Products.

2. Brady Corporation.
 3. Marking Services, Inc.
 4. Brimar Industries, Inc.
- B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass wire-link chain or beaded chain or S-hook.
- C. 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. Products of indicated manufacturers are acceptable.
1. Seton Identification Products.
 2. Brady Corporation.
 3. Marking Services, Inc.
 4. Brimar Industries, Inc.
- B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
1. Size: 3 by 5-1/4 inches minimum.
 2. Fasteners: Brass grommet and wire.
 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 4. Color: Safety-yellow background with black lettering.

2.6 STEAM TRAP TAGS

- A. Construct or stamp from not less than No. 14 gage brass or aluminum and not less than 1 1/2 inches diameter. Approved Model: Brady B-907.
- B. Provide No. 10 gage brass "S" hook and brass chain to securely fasten tag to steam trap.
- C. Permanently stamp and mark with service designation and unique identifying number as large as possible.

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 GENERAL INSTALLATION REQUIREMENTS

- 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.
- D. Relocate any mechanical identification marker or tag that has become visually blocked by work of this trade or other trades.
- E. Clean identification markers and tags immediately prior to concealing work.

3.3 PAINTING OF PIPING

- A. Field-paint uninsulated steel piping in accordance with Painting: Division 09.

3.4 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.5 PIPE LABEL INSTALLATION

- A. Pipe Label Locations: 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 and on both sides of 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.
- B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

3.6 IDENTIFICATION SCHEDULES

- A. Legends to be used for piping and equipment shall be as listed on the "Symbols" and "Abbreviations" sheets of the Drawings. Select color fields and legend colors from Table 2 of ANSI Standard A13.1, using the criteria that fluids with a temperature above 100 degrees F or with a pressure equal to or above 150 psig are categorized as inherently hazardous. Select the size of legend letters per ANSI Standard A13.1.

3.7 DUCT LABEL INSTALLATION

- A. Install plastic-laminated self-adhesive 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.
- B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.8 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: 1-1/2 inches.
- b. Condenser Water: 1-1/2 inches.
- c. Refrigerant: 1-1/2 inches.
- d. Hot Water: 1-1/2 inches.
- e. Gas: 1-1/2 inches.

3.9 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 230593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Section Includes:
 - 1. Balancing Air and Hydronic Systems.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 SUBMITTALS

- A. Submit per the requirements of Division 01.
- B. Quality Control Procedures:
 - 1. Inspection Reports: Every week prior to and during testing and balancing.
 - 2. Testing and Balancing Procedures: Written step-by-step procedures to be used for testing and balancing of each system thirty (30) days before starting Work. Step-by-step procedures shall include specific reference to components and sequence of testing, adjusting, and balancing. Include estimated start and completion dates for testing and balancing each system. As an example:
 - a. Adjust speed of supply and return fans "X" and "Y" for required speed, revolutions per minute (rpm).
 - b. Confirm fan flowrate and dynamic head as conforming to submitted fan curve.
 - c. Set and mark manual damper settings for balanced flow.
 - d. Adjust directional vanes on registers, grilles, and diffusers for proper spread and blow.
 - e. By balancing airflow at each air terminal for Constant Volume (CV) systems and adjusting thermostats at each Variable Air Volume (VAV) air terminal, establish design flowrate at fan and confirm fan head. Take readings at terminals on longest run. Examine VAV control system to ensure that the proper connections have been made in order to test and confirm, for example, design airflow rates and pressure drops.
 - f. At design flowrate:
 - 1) Measure inlet static pressure to each air terminal. Report deficiencies where static pressure is less than that required.
 - 2) Modulate thermostat at each reheat coil to ensure response and measure discharge air temperature at design room conditions.
 - 3. List of test instruments and calibration dates to be used for each test.
- C. Testing and Balancing (TAB) Reports: Including preliminary and final balance data sheets, and thermal performance test of cooling towers.
 - 1. Three (3) copies of written reports, during course of construction, of potential or developing problems and delays relating to Work being provided, where such problems may adversely affect proper TAB of equipment or systems.
 - 2. Written reports for review upon completion of each major phase of TAB Work.
 - 3. Reports of delayed TAB Work promptly after execution of those services.
 - 4. Final TAB Report in accordance with requirements specified in this Section, modified and expanded to be compatible with requirements of installed system.
 - 5. Form of Final Reports:
 - a. Each final reporting form must bear signature of person who recorded data, and the seal and signature of TAB supervisor of reporting organization.
 - b. When more than one (1) certified organization performs TAB services, firm having managerial responsibility shall make submittals.
 - c. Identify instruments of all types that were used and last date of calibration of each.
- D. Certifications:
 - 1. Associated Air Balance Council (AABC), National Environmental Balancing Bureau (NEBB) Certification or Testing, Adjusting and Balancing Bureau (TABB).
 - 2. Test Instrument Agency.

1.5 QUALITY ASSURANCE

- A. Testing and Balancing Agency shall be certified by Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB) or Testing, Adjusting and Balancing Bureau (TABB).
- B. TAB Work performed by Testing and Balancing Agency shall be under direct supervision of a Professional Mechanical Engineer registered in State of Project, who is experienced in testing and balancing of mechanical systems, and who is a full-time employee of Testing and Balancing Agency. Technicians performing TAB Work must be properly trained, experienced and full-time employees of Testing and Balancing Agency.
- C. Testing and Balancing Agency shall be approved by Owner's Representative.
- D. Within 30 days after Award of Contract, transmit the following to Owner's Representative:
 - 1. Name of organization proposed to perform TAB Work.
 - 2. Proof of having balanced and tested at least five (5) projects of similar size and scope if requested.
 - 3. Should separate firms perform services for air and hydronic portions, certify firm that will have managerial responsibilities for coordination of entire testing and balancing process.
- E. Comply with applicable procedures and standards of certification-sponsoring association, unless more stringent requirements are specified in this Section; either:
 - 1. Current issue of "National Standards for Total System Balance" published by AABC.
 - 2. Current issue of "Procedural Standards for TAB for Environmental Design 7th Ed." published by NEBB.
 - 3. Current issue of "International Standards for Environmental Systems Balance" published by TABB.
- F. Calibrate and maintain test instruments in accordance with requirements of referenced standards. Calibrate instruments used in performance of TAB Work within six (6) months preceding date of usage. Calibration histories for each instrument shall be included with TAB Report.
 - 1. Accuracy of measurements shall comply with more stringent of requirements of standards or tolerances indicated.
- G. Balancing Tolerances:
 - 1. Air Systems: Balance equipment, air outlets and air intakes in accordance with air quantities indicated with permissible tolerances as follows:
 - a. Supply, Return and Exhaust Fans: Minus 5 percent to plus 10 percent.
 - b. Supply, Return, Exhaust, and Transfer to Individual Room: Minus 5 percent to plus 10 percent.
 - c. Individual Outlet, Intake or Transfer for Room with Multiple Outlets, Intakes or Transfer: Plus or minus 10 percent.
 - 2. Hydronic Systems: Balance equipment in accordance with capacities and flow quantities indicated with a permissible tolerance of minus 5 percent to plus 10 percent.
- H. Referenced Codes and Standards: Comply with the following in accordance with Division 01.
 - 1. American National Standards Institute/American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ANSI/ASHRAE)
111 Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems
 - 2. Air-Conditioning, Heating and Refrigeration Institute (AHRI)

- 640 Performance Rating of Commercial and Industrial Humidifiers
3. Associated Air Balance Council (AABC)

National Standards for Total System Balance

4. Testing, Adjusting and Balancing Bureau (TABB)
International Standards for Environmental Systems Balance

1.6 PROCEDURES

- A. Visit Project Site monthly, or more frequently, during installation of Work. When potential or developing problems be discovered relating to materials, equipment or methods being used in Work, and where such problems may adversely affect TAB Work, immediately report these findings in writing to Design Professional with written recommendations for correction.

1.7 WARRANTY AND CONTRACT CLOSEOUT

- A. Warranty:
 1. Provide a National Certification Guarantee from the AABC, NEBB or TABB, applicable for the TAB Work performed under this Contract.
 2. After completion of the Work specified under this Section, provide an extended warranty encompassing one (1) full heating season and one (1) full cooling season, during which time any balancing device which had been adjusted earlier as part of this Work shall be rechecked and reset when such additional Work is deemed necessary by Owner's Representative or Design Professional.
- B. Contract Closeout:
 1. Submit reports for:
 - a. Air distribution systems balancing, including status report of existing conditions prior to start of work.
 - b. Water systems balancing, including status report of existing conditions prior to start of work.
 - c. Performance of Automatic Temperature Control System.
 2. Submit National Certification Guarantee from AABC, NEBB or TABB.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Furnish test instruments, materials, and equipment and any fuels, other than electricity, required for testing.
- B. Test and calibrate instruments installed in systems to be tested and those portable instruments to be used for testing.

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 equipment performance data including fan 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.
- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. 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.
- I. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- J. Examine operating safety interlocks and controls on HVAC equipment.
- K. 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 GENERAL

- A. Adjust, test, and confirm design flowrates, pressure drops, pressures, temperatures, and heat transfer performance for mechanical systems, including, but not limited to, chilled water system, condenser water system, glycol/water system, hot water heating system, computer room cooling system, supply air, return air, outdoor air, transfer air, relief air, makeup air and exhaust air systems, including associated pumps, chillers, heat exchangers, boilers, cooling towers, coils, fans, dampers, diffusers, Airflow Measuring Devices (AMD), terminal devices, valves and accessories.
- B. Perform work in two (2) phases, preliminary and final testing and balancing. Initiate preliminary testing and balancing immediately after mechanical installer's certification of system performance, for example, before controls, ceilings and walls are completed. Confirm that source devices, including fans, pumps and converters are operating within 10 percent of their scheduled values. Follow preliminary phase by a submitted written report of system shortcomings which prohibit final balancing. Following preliminary testing and balancing, if balancing or control devices are not operating correctly, report these conditions to Construction Manager HVAC Subcontractor who shall make, coordinate, direct Work to make required corrections so that balancing can continue. Send a copy of report to Owner's Representative, Design Professional and Construction Manager.
- C. Perform Work, using methods and test forms published by AABC National Standards for Total System Balance, or using equivalent NEBB or TABB methods and forms, except as modified in this Section.
- D. Start final testing and balancing after each system has been certified by Mechanical Installer to be complete.
- E. Using controls and devices installed, test and balance air conditioning systems with maximum attainable internal load, including lights and equipment, or simulated maximum load using automatic temperature controls, whichever is closest to design operating conditions.
- F. Perform final testing and balancing of air handling systems and sound testing with finished ceilings and partitions in place, and doors closed.
- G. Have on Project Site AABC, NEBB or TABB standards referred to in this Section, and make them available to Mechanical installer and Owner's Representative.
- H. Owner's Representative may witness final testing and balancing of systems. Notify Owner's Representative, prior to each system being tested or balanced.
- I. Repair or replace finished products damaged by personnel employed by Testing and Balancing Agency as a result of testing, balancing and inspection work. Repair or replace finished products damaged in providing access to areas or in providing support for testing and balancing work.
- J. In general, rate of transfer air in spaces shall be constant between maximum and minimum airflow setpoints for control of room relative pressure. Rate of transfer air is indicated on Drawings. Verify that transfer air rate is in conformance with indicated values, and recommend required corrective action if transfer air rate difference is greater than 10 percent between maximum and minimum airflow setpoints. Report deviations from Contract Documents required to accomplish design transfer air rates to Design Professional.

- K. Perform complete balancing services for standby equipment. Verify and report that final terminal device flows and transfer airflows are achieved when operation is switched to standby equipment.

3.3 INSTRUMENTATION CALIBRATION

- A. Submit written certification of accuracy of instruments. Show date and method of calibration. Instruments shall have been calibrated within six (6) months prior to estimated commencement date of testing and balancing work.
- B. Verify the accuracy of permanently-installed flow-measuring primary elements and their read-out instruments, thermometers, sensors, and pressure gauges furnished by Mechanical Installer. Verification may be by calculation and calibration of primary element and read-out instrument, or by an independent measurement of flow, temperature or pressure of flow, of same flowing medium using calibrated instruments. Submit a report of accuracy of calibrations.

3.4 BALANCING PROCEDURES AND RELATED WORK

- A. Balancing shall achieve design air, and hydronic flowrates, within specified tolerances at terminal points, including air outlets, inlets, transfer air quantities and coil flowrates. Flowrates at fans and pumps shall be within indicated tolerances from flows indicated on Drawings, specified or scheduled. Where supply and return air fans of air handling units are of variable air volume (VAV) operation type, adjust both fans for similar control ranges. Transfer airflow direction shall be in accordance with Drawings in all modes of operation and flow shall be measured, where possible, rather than mathematically derived from supply, return and exhaust flows.
- B. Verify that controls and final control elements, including valves, louvers, dampers, heat pumps, fume hoods and terminal boxes, operate as intended and in sequence specified. Report device failures in preliminary reports submitted every week.
- C. Where variable or initial fixed sheaves have been provided, determine correct fan rpm, and advise mechanical installer of correct fan rpm and required fixed-sheave diameter. Final fixed sheaves shall be sized such that, upon final balancing, balancing devices at fan and in highest pressure drop duct run are open. Do not "choke" excess fan capacity to achieve final system balance; instead, decrease fan speed (rpm) as required. Check and verify fan speed (rpm) following installation of fixed sheaves.
- D. Balance fan systems with filters to design airflow with simulated dirty filter condition, as indicated on Equipment Schedules. Variable-frequency motor drives shall not be at 100 percent when filters are in clean condition.
- E. Permanently-installed flow-measuring elements may be used to accomplish balancing after accuracy has been verified with certified calibrated instruments. Record and report readouts of these instruments for all flows, even if not required for testing and balancing results.
- F. Adjust variable-speed pump/fan controls for proper setting to produce design water/airflow rates.
- G. Protect read-out instruments from damage, and return them in good working order to Mechanical Installer.

- H. Only direct-flow measurements are acceptable. Do not use indirect calculations, such as a heat balance or pressure drop, unless authorized by Owner's Representative and/or Design Professional.
- I. Balance air system minimum and maximum damper positions for correct operation at all operating conditions.
- J. Balance air systems in all modes of operation, including unoccupied, occupied non-production, occupied in-production, warm-up, economizer, equipment failure, clean agent fire suppression evacuation and smoke control modes.
- K. Provide required openings for duct traverses. Seal test holes in ducts with snap-in plugs. Tape is not acceptable. Repair insulation where damaged. Mark insulation or exterior of duct where readings were taken.
- L. Record test data for each motor, fan, pump, air system, heat exchanger, boiler, cooling tower, chiller and condenser. Apply temperature, barometric and other correction factors for non-standard conditions and record in report.

3.5 TESTS AND RECORDS

- A. Submit a separate test report for each air and hydronic system containing actual temperatures, pressure drops and flowrates at terminal devices, including terminal boxes, diffusers, fume hoods and coils, and compare totals to flow measurements taken at source, including fans and pumps and to design parameters.
- B. In addition, record test data where applicable on the following test forms defined in Chapter 26 of AABC National Standards for Total System Balance or equivalent NEBB or TABB forms. Modify forms as necessary to report information requested in this Section.
- C. In addition to tests and records for foregoing equipment, tests, and records are required for the following equipment:
 - 1. Heat transfer and reheat coils, including nameplate data and, for both design and actual conditions, the following:
 - a. Inlet and outlet air temperature and, for cooling, both wet and dry bulb temperatures on 2 foot vertical and horizontal centers at air handlers.
 - b. Air pressure drop.
 - c. Air face velocity on 2 foot vertical and horizontal centers at air handlers.
 - d. Chilled water, hot water and glycol/water pressure, in and out.
 - e. Chilled water, hot water and glycol/water pressure drop.
 - f. Outside air temperature.
 - g. Entering and leaving coil fluid temperatures and flow.
 - h. Calculate air BTU/hr versus liquid BTU/hr.
 - 2. Heat exchangers, including nameplate data, and both design and actual inlet and outlet water temperature and pressure drop at full flow through unit.
 - 3. Air filters and air handling units, including air pressure drop across filters and entire unit.
- D. In addition to data required on AABC, NEBB or TABB forms, the following additional information is required for scheduled equipment:
 - 1. Motors: Type, amps per phase, frame number, serial number, motor horsepower, and calculated driven equipment brake horsepower and efficiency at final conditions.

2. Fans: Blade design type such as Air Foil (AF), Backwardly Inclined (BI), Forward Curved (FC), Single Width Single Inlet (SWSI) or Double Width Double Inlet (DWDI), class and number of blades.
3. Pumps:
 - a. Design Data: Impeller size, motor hp, rpm, net positive suction head (NPSH) required at design flow, and total dynamic head (TDH) at zero flow.
 - b. Test Data: Suction and discharge pressures at full flow (not throttled to obtain rated flow), and zero flow.
4. Hydronic Systems: Flowrate in each significant branch, position of each balancing valve, and flowrate to each unit, including each cell of cooling tower.
5. Test and record volume and pressure into and out of variable-volume or constant-volume air terminal boxes for all modes of operation. Recalibrate factory setting of volume on box if it differs from Design Documents.
6. Test inlet pressure to Variable Air Volume (VAV) terminal boxes, and confirm performance, minimum/maximum airflow, response to thermostat or static pressure sensor, and minimum closure airflow.
7. Fan and Pump Systems: For systems controlled by static pressure, assure by test and recording that devices, including high-limit controls are calibrated to perform in accordance with Contract Documents, and provide design static pressure at most distant location. Furnish and coordinate static pressure setpoint of controls, as applicable, with the installation of DDC System. Test fans and pumps that are driven by variable-frequency drives over their operating range. Conduct vibration tests on VFD-driven equipment over their entire operating range.
8. Calculate actual air change rate for each room based on actual supply, return, and exhaust air quantities.
9. Calculate, for each room, percent deviation between actual supply, return, and exhaust air quantities and supply, return, and exhaust air quantities indicated on Drawings.

3.6 SOUND TESTS

- A. At locations to be designated later, conduct sound tests in accordance with procedures published by AABC, NEBB or TABB, except as modified by the following:
 1. At each designated location, measure sound pressure level at each octave band mid-frequency between 63 and 8000 Hz as follows:
 - a. With all room equipment off, room empty of personnel except test personnel, all windows and doors closed, and HVAC systems operating.
 2. Based on these sound pressure level measurements, calculate and report "NC" rating and sound level (dBA) for each designated location. Plot center frequencies for each octave band on NC curve charts.
- B. Observe and report equipment, piping, air outlets, and ductwork for excessive noise, movement or vibration.
- C. If an NC curve or a maximum decibel sound level is specified and exceeded, identify loud noise sources. Make recommendations in writing for correction.
- D. Conduct sound tests in the following locations:
 1. Twenty locations designated by the Owner.

3.7 TESTING AND BALANCING REPORTS

- A. Submit preliminary and final testing and balancing reports for approval.
- B. Arrange recorded data by system, using the appropriate designations as established in Contract Documents. Submit signed, bound, and indexed copies of both preliminary and final reports to Owner's Representative and Design Professional.
- C. Where actual measurements recorded for final balance show deviation of more than 5 percent from design balancing point, and deviation cannot be corrected by balancing with installed layout and elements, note this deviation in final report with written recommendations for corrective action.
- D. In those cases where recorded data can be reasonably interpreted to be inaccurate, inconsistent or erroneous, Owner's Representative may request additional testing and balancing. Perform such retesting and rebalancing, at no additional cost, as directed by, and in presence of Owner's Representative.
- E. Where, in opinion of Testing and Balancing Agency, there is excessive vibration, movement, or noise from any piece of equipment, ductwork, or piping, note these conditions in final report with written recommendations for corrective action.

3.8 DUCTWORK LEAK TEST WITNESSING

- A. Witness ductwork leak testing conducted by Mechanical Installer under Section 233113. Advance notice of three (3) working days will be provided. Ductwork may be tested in sections and must be tested within ten (10) working days of installation.
- B. Inspect ductwork installation and ductwork leak testing setup to ensure compliance with Section 233113, and shall verify Mechanical Installer's instrument readings and sign Mechanical Installer's test documentation.

END OF SECTION

SECTION 230713
DUCT INSULATION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Section includes duct insulation.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. 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 III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Subject to compliance with requirements, the following products are approved.
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.
- F. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Subject to compliance with requirements, the following products are approved.
 - 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.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Subject to compliance with requirements, the following products are approved.
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Subject to compliance with requirements, the following products are approved.
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
 - d. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Subject to compliance with requirements, the following products are approved.
 - a. Dow Corning Corporation; 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; Polyco VP Adhesive.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
- Subject to compliance with requirements, the following products are approved.
 - Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - Vimasco Corporation; 749.
 - Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - Service Temperature Range: Minus 20 to plus 180 deg F.
 - Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
- Subject to compliance with requirements, the following products are approved.
 - Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - Eagle Bridges - Marathon Industries; 550.
 - Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - Mon-Eco Industries, Inc.; 55-50.
 - Vimasco Corporation; WC-1/WC-5.
 - Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 - Service Temperature Range: Minus 20 to plus 180 deg F.
 - Solids Content: 60 percent by volume and 66 percent by weight.
 - Color: White.

2.4 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
- Subject to compliance with requirements, the following products are approved.
 - Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - Eagle Bridges - Marathon Industries; 405.
 - Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - Mon-Eco Industries, Inc.; 44-05.

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 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Subject to compliance with requirements, the following products are approved.
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 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, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
 5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.6 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.
1. Subject to compliance with requirements, the following products are approved.
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.

2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Subject to compliance with requirements, the following products are approved.
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - 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. Subject to compliance with requirements, the following products are approved.
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 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. Subject to compliance with requirements, the following products are approved.
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. 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. Subject to compliance with requirements, the following products are approved.
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - 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.

2.8 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

1. Subject to compliance with requirements, the following products are approved.

- a. ITW Insulation Systems; Gerrard Strapping and Seals.
- b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

B. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Subject to compliance with requirements, the following products are approved.

- 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
- 2) GEMCO; Perforated Base.
- 3) Midwest Fasteners, Inc.; Spindle.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.

d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Subject to compliance with requirements, the following products are approved.

- 1) GEMCO; Nylon Hangers.
- 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.

c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.

d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Subject to compliance with requirements, the following products are approved.

- 1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
- 2) GEMCO; Peel & Press.
- 3) Midwest Fasteners, Inc.; Self Stick.

b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

- c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
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. Subject to compliance with requirements, the following products are approved.
 - 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.
5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Subject to compliance with requirements, the following manufacturers are approved.
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, galvanized steel.
1. Subject to compliance with requirements, the following manufacturers are approved.
 - a. C & F Wire.
- 2.9 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.
- 2.10 PANELIZED EXTERIOR DUCT INSULATION
- A. Approved manufacturers: PTM Manufacturing "Techna-Duc".
 - B. Insulation shall be a shop-fabricated panel system, manufactured as a four-piece interlocking panel.
 - C. Insulation Material: Glass reinforced polyisocyanurate foam insulation encased in 1.25 mil aluminum foil.

- D. Thickness: Laminated 1 1/2 inch and 1/2 inch polyisocyanurate sheets totaling a finish of 2 inches thick; a minimum of 1/2 inch thickness required to cover duct supports and connection flanges (R-14 to R-16 required).
- E. Weather Barrier: Mill finished embossed aluminum sheeting, 0.032 inch thick. Cover exposed seams with 1 inch butyl and a 3 inch embossed aluminum beaded bands, secured with No. 10 self tapping, stainless screws with weather seal washers.
- F. Vapor Barrier: Seal longitudinal and circumferential joints from vapor migration, with a non-setting vapor barrier bedding compound joint sealant.
- G. Caulking Compound: At weather barrier abutment locations, use an industrial grade RTV silicone caulk.
- H. Putty/Butyl Caulk: Cover and seal seams exposed to the weather with a 1 inch wide by 1/8 inch thick butyl compound.
- I. Contact Cement: Use contact cement or 2-sided adhesive tape for laminating insulation material to the weather barrier sheeting.
- J. Tape: Foil tape used for sealing the insulation edges shall be thickness of 1.25 mil.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.

- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.

- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Comply with requirements in Section 078410 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
 - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078410 "Penetration Firestopping."

3.4 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 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 one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 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 two 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.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 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 one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 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 two 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.

3.5 INSTALLATION-DUCT LAGGING SYSTEM

- A. Cut sound lagging material to length, wrap around the outside of the pipe or duct, and fasten with mechanical fasteners or band. Use tape and adhesive in conjunction with mechanical fasteners or bands. Install sound lagging materials per the manufacturer's installation guidelines.

3.6 FINISHES

- A. Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09.

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. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless-steel jackets.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Inspect ductwork, randomly selected by Owner, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 DUCT INSULATION SCHEDULE, GENERAL

- A. Items Not Insulated:
 1. Fibrous-glass ducts.
 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 3. Factory-insulated flexible ducts.
 4. Factory-insulated plenums and casings.
 5. Flexible connectors.
 6. Vibration-control devices.
 7. Factory-insulated access panels and doors.

3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket 1.5 inches thick, 3 pounds per cubic feet (pcf) density.
- B. Return-Air Duct and Plenum Insulation in Mechanical Rooms: Mineral-fiber blanket, 1.5 inches thick, 3 pounds per cubic feet (pcf) density.
- C. Outdoor-Air Duct and Plenum Insulation located indoors, and louver blankoff panels: Mineral-fiber blanket, 2 inches thick, 6 pounds per cubic feet (pcf) density.

3.10 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. A. Fit interlocking panel system into place on rectangular ductwork. Prior to fitting, a minimum of a 3/8 inch bead of joint sealant shall be applied at each joint to serve as a vapor barrier.
- B. Fit material so that the vapor barrier seal is continuous and does not allow for water vapor infiltration.
- C. After fitting, fasten the panel system with No. 10 selftapping, stainless steel, and vapor seal screws on a maximum of 12 inches on center. For duct wider than 48 inches, use a bottom fastener.
- D. At circumferential joints, roll a 1 inch wide by 1/8 inch thick butyl compound putty onto the joint using a laminate roller sized to overlap the tape.
- E. Cover the butyl compound with a 3 inch wide embossed aluminum beaded band fabricated from the same metal as the jacketing material. Seal seams of the aluminum cap with a 3/8 inch bead of RTV caulk, colored to match the panel system and screwed in place with screws with weather sealed washers on 6 inches centers.
- F. Size panel system to provide a top and side panel overlap equal to the thickness of the insulation being applied.
- G. Laminate insulation to the weather barrier and size to allow for overlap. Adhere insulation using appropriate contact method.
- H. Construct each panel so that vertical and horizontal insulation seams will have an interlocking and overlapping shiplap style joint. The overlap shall be a minimum of 1/2 inch thick material.
- I. The Installing Contractor shall either be a certified product installer, or work with insulation manufacturer to become certified. Allow a minimum of two (2) days for this effort.

END OF SECTION

SECTION 230719
HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Section includes insulating HVAC piping systems:

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 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.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Field quality-control reports.

1.5 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. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to 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 agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 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.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

- B. Coordinate clearance requirements with piping Installer for piping 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.

1.8 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. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Subject to compliance with requirements, the following manufacturers are approved.
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. K-Flex USA.

2. Elastomer: 5 pcf density, maximum thermal conductivity (k) of 0.27 (BTU) (inch)/(hour) (square foot) (degree F) at 75 degrees F. "AP Armaflex", "AP Armaflex SS", "AP Armaflex W" or "HT Armaflex" by Armacell.

F. Mineral-Fiber, Preformed Pipe Insulation:

1. Subject to compliance with requirements, the following manufacturers are approved.
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Knauf Insulation.
 - c. Manson Insulation Inc.
 - d. Owens Corning.
2. Type I: Mineral or glass fibers bonded with a thermosetting resin. Nominal minimum 4 pcf density, maximum thermal conductivity (k) of 0.23 (BTU) (inch)/(hour) (square foot) (degree F) at 75 degrees F. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

G. Polyisocyanurate, Preformed Pipe Insulation:

1. As an Alternate, Preformed Polyisocyanurate Insulation is approved for chilled water and heating hot water piping. Polyisocyanurate Insulation shall have the following characteristics: Nominal minimum 2.0 pcf density, maximum thermal conductivity (k) of 0.18 (BTU) (inch)/(hour) (square foot) (degree F) at 75 degrees F. Comply with ASTM C 591, Class 1 ASTM E 84, with factory-applied jacket.
 - a. Dyplast Products.
 - b. Smock & Schonhaler.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. Subject to compliance with requirements, the following manufacturers are approved.
 - a. Ramco Insulation, Inc.
- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
 - 1. Subject to compliance with requirements, the following manufacturers are approved.
 - a. Ramco Insulation, Inc.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Subject to compliance with requirements, the following manufacturers are approved.
 - a. Armacell LLC.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. K-Flex USA.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Manufacturers: Subject to compliance with requirements, the following manufacturers are approved.
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Subject to compliance with requirements, the following manufacturers are approved.
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Mon-Eco Industries, Inc.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Subject to compliance with requirements, the following manufacturers are approved.
 - a. Dow Corning Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Speedline Corporation.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
 1. Subject to compliance with requirements, the following manufacturers are approved.
 - a. Foster Brand; H. B. Fuller Construction Products.
 - b. Knauf Insulation.
 - c. Vimasco Corporation.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, 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, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
1. Subject to compliance with requirements, the following manufacturers are approved.
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
 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. Subject to compliance with requirements, the following manufacturers are approved.
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 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. Subject to compliance with requirements, the following manufacturers are approved.
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Knauf Insulation.
 - d. Mon-Eco Industries, Inc.
 - e. Vimasco Corporation.
 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.

4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Subject to compliance with requirements, the following manufacturers are approved.
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

1. Subject to compliance with requirements, provide products by one of the following.
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
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, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and PVC Jacket Flashing Sealants:

1. Subject to compliance with requirements, provide products by the following.
 - a. Childers Brand; H. B. Fuller Construction Products.
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, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FACTORY-APPLIED JACKETS

A. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
 - 1. Subject to compliance with requirements, the following manufacturers are approved.
 - a. Childers Brand; H. B. Fuller Construction Products.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in.
 - 1. Subject to compliance with requirements, provide products by one of the following.
 - a. Foster Brand; H. B. Fuller Construction Products.
 - b. Vimasco Corporation.

2.8 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.
 - 1. Subject to compliance with requirements, provide products by the following.
 - a. Alpha Associates, Inc.

2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. 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. Subject to compliance with requirements, the following manufacturers are approved.
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. P.I.C. Plastics, Inc.
 - c. Proto Corporation.
 - 2. Adhesive: As recommended by jacket material manufacturer.
 - 3. Color: White.
 - 4. 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, and unions, reducers.
- D. Metal Jacket:
 - 1. Subject to compliance with requirements, the following manufacturers are approved.
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. ITW Insulation Systems; Illinois Tool Works, Inc.
 - c. RPR Products, Inc.
 - 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - 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.

2.10 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Subject to compliance with requirements, the following manufacturers are approved.
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Compac Corporation.
 - c. Ideal Tape Co., Inc., an American Biltrite Company.
 - d. Venture Tape.
 - 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. Subject to compliance with requirements, the following manufacturers are approved.
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Compac Corporation.
 - c. Knauf Insulation.
 - d. Venture Tape.
 - 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. Subject to compliance with requirements, the following manufacturers are approved.
 - a. Compac Corporation.
 - b. Ideal Tape Co., Inc., an American Biltrite Company.
 - c. Venture Tape.
 - 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. Subject to compliance with requirements, the following manufacturers are approved.
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Compac Corporation.
 - c. Ideal Tape Co., Inc., an American Biltrite Company.
 - d. Knauf Insulation.
 - 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.

2.11 SECUREMENTS

- A. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water.

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 piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Seal raw edge of insulation.
- D. 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.
- E. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- F. Install multiple layers of insulation with longitudinal and end seams staggered.
- G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- H. Keep insulation materials dry during application and finishing.

- 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 2 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- 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 Section 078410 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078410 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. 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, 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.
- B. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- 3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION
- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install 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.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

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. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install 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.

3.8 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. 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.

3.9 FINISHES

A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09.

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 on insulation installed outdoor.
 - 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.
- 3.10 FIELD QUALITY CONTROL
- A. Perform tests and inspections.
 - B. Tests and Inspections:
 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Owner, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
 - C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. 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.

3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Apply PVC jacket over all insulation (including straight pipe runs and fittings) where exposed to view.
- B. Insulate fill expansion and makeup water with thickness and material to match the associated system.
- C. Condensate and Equipment Drain Water:
1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.

- b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

D. Chilled Water and Soft Water:

- 1. NPS 12 and Smaller: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I 1-1/2 inches.
- 2. NPS 14 and Larger: Insulation shall be:
 - a. Mineral-Fiber Preformed Pipe, Type I: 1-1/2 inches thick.

E. Condenser-Water Supply and Return:

- 1. NPS 12 and Smaller: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick.
- 2. NPS 14 and Larger: Insulation shall be:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inches thick.

F. Heating-Hot-Water Supply and Return and Cogeneration Heat Recovery Water:

- 1. NPS 12 and Smaller: Insulation shall be:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.

2. NPS 14 and Larger: Insulation shall be:
 - a. Mineral-Fiber, Preformed Pipe, Type I or Pipe and Tank Insulation: 2 inches thick.

G. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be:
 - a. Flexible Elastomeric: 1 inch thick.

3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Chilled Water:

1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 3 inches thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 3 inches thick.

B. Condenser-Water Supply and Return:

1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 2 inches thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

C. Heating-Hot-Water Supply and Return, 200 Deg F and Below:

1. All Pipe Sizes: Insulation shall be:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

D. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be:

- a. Flexible Elastomeric: 2 inches thick.
 - E. Fuel Oil Piping, Heated:
 - 1. All Pipe Sizes: Insulation shall be:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
 - F. Heat-Traced Piping:
 - 1. All Pipe Sizes: Insulation shall be:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
- 3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE
- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
 - B. Piping, Concealed:
 - 1. Aluminum, Smooth: 0.024 inch thick.
 - C. Piping, Exposed:
 - 1. Painted Aluminum, Smooth with Z-Shaped Locking Seam: 0.024 inch thick.

END OF SECTION

SECTION 232300
REFRIGERANT PIPING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Section Includes:
 - 1. Refrigerant pipes and fittings.
 - 2. Refrigerant piping valves and specialties.
 - 3. Refrigerants.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty.
 - 1. Include pressure drop, based on manufacturer's test data, for the following:
 - a. Thermostatic expansion valves.
 - b. Solenoid valves.
 - c. Hot-gas bypass valves.
 - d. Filter dryers.
 - e. Strainers.
 - f. Pressure-regulating valves.
- B. Shop Drawings:

1. Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes; flow capacities; valve arrangements and locations; slopes of horizontal runs; oil traps; double risers; wall and floor penetrations; and equipment connection details.
2. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
3. Show interface and spatial relationships between piping and equipment.
4. Shop Drawing Scale: 1/4 inch equals 1 foot.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to 2010 ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.7 PRODUCT STORAGE AND HANDLING

- A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
 - 2. Hot-Gas and Liquid Lines: 535 psig.

2.2 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8/A5.8M.
- F. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
 - 4. Working Pressure Rating: Factory test at minimum 500 psig.
 - 5. Maximum Operating Temperature: 250 deg F.

2.3 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
 - 1. Approved Manufacturers.
 - a. Henry Technologies.
 - b. Sporlan.
 - c. Ranco.
 - 2. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
 - 3. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
 - 4. Operator: Rising stem and hand wheel.

5. Seat: Nylon.
6. End Connections: Socket, union, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

B. Check Valves:

1. Approved Manufacturers.
 - a. Henry Technologies.
 - b. Sporlan.
 - c. Ranco.
2. Body: Forged brass, or cast bronze; globe pattern.
3. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
4. Piston: Removable polytetrafluoroethylene seat.
5. Closing Spring: Stainless steel.
6. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
7. End Connections: Socket, union, threaded, or flanged.
8. Maximum Opening Pressure: 0.50 psig.
9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 275 deg F.

C. Service Valves:

1. Approved Manufacturers.
 - a. Henry Technologies.
 - b. Sporlan.
 - c. Ranco.
2. Body: Forged brass with brass cap including key end to remove core.
3. Core: Removable ball-type check valve with stainless-steel spring.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Copper spring.
6. Working Pressure Rating: 500 psig.

D. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (NRTL).

1. Approved Manufacturers.
 - a. ASCO.
 - b. Honeywell.
 - c. GG Values.
2. Body and Bonnet: Plated steel.
3. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Threaded.

6. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and 115-V ac coil.
 7. Working Pressure Rating: 400 psig.
 8. Maximum Operating Temperature: 240 deg F.
- E. Safety Relief Valves: Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Approved Manufacturers.
 - a. Watts Regulator Co.
 - b. Henry Technologies.
 - c. Sporlan.
 - d. Ranco.
 - e. Webster
 - f. Lonergan.
 - g. Bell and Gossett.
 2. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
 3. Piston, Closing Spring, and Seat Insert: Stainless steel.
 4. Seat: Polytetrafluoroethylene.
 5. End Connections: Threaded.
 6. Working Pressure Rating: 400 psig.
 7. Maximum Operating Temperature: 240 deg F.
- F. Thermostatic Expansion Valves: Comply with AHRI 750.
1. Approved Manufacturers.
 - a. Henry Technologies.
 - b. Sporlan.
 - c. Ranco.
 2. Body, Bonnet, and Seal Cap: Forged brass or steel.
 3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 4. Packing and Gaskets: Non-asbestos.
 5. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 6. Suction Temperature: 40 deg F.
 7. Superheat: Adjustable.
 8. End Connections: Socket, flare, or threaded union.
 9. Working Pressure Rating: 450 psig.
- G. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
1. Approved Manufacturers.
 - a. Rawal Devices, Inc.
 2. Body, Bonnet, and Seal Cap: Ductile iron or steel.
 3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 4. Packing and Gaskets: Non-asbestos.
 5. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 6. Seat: Polytetrafluoroethylene.

7. Equalizer: External.
8. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter and 115-V ac coil.
9. End Connections: Socket.
10. Set Pressure.
11. Throttling Range: Maximum 5 psig.
12. Working Pressure Rating: 500 psig.
13. Maximum Operating Temperature: 240 deg F.

H. Straight-Type Strainers:

1. Approved Manufacturers.
 - a. Mueller Industries.
 - b. Sporlan.
 - c. Ranco.
2. Body: Welded steel with corrosion-resistant coating.
3. Screen: 100-mesh stainless steel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

I. Moisture/Liquid Indicators:

1. Approved Manufacturers.
 - a. Henry Technologies.
 - b. Sporlan.
 - c. Parker.
 - d. Ranco.
2. Body: Forged brass.
3. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
4. Indicator: Color coded to show moisture content in parts per million (ppm).
5. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
6. End Connections: Socket or flare.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

J. Replaceable-Core Filter Dryers: Comply with AHRI 730.

1. Approved Manufacturers.
 - a. Sporlan.
 - b. Parker.
 - c. Henry Technologies.
 - d. Ranco.
2. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
3. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
4. Desiccant Media: Activated charcoal.

5. Designed for reverse flow (for heat-pump applications).
6. End Connections: Socket.
7. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
8. Maximum Pressure Loss: 2 psig.
9. Rated Flow.
10. Working Pressure Rating: 500 psig.
11. Maximum Operating Temperature: 240 deg F.

K. Receivers: Comply with AHRI 495.

1. Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
2. Comply with UL 207; listed and labeled by an NRTL.
3. Body: Welded steel with corrosion-resistant coating.
4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
5. End Connections: Socket or threaded.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

L. Liquid Accumulators: Comply with AHRI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

2.4 REFRIGERANTS

- A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type K, annealed-temper tubing and wrought-copper fittings with brazed joints.

- B. Suction Lines NPS 3-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type K (B), drawn-temper tubing and wrought-copper fittings with brazed joints.
- C. Suction Lines NPS 4 and Smaller for Conventional Air-Conditioning Applications: Copper, Type K (A), drawn-temper tubing and wrought-copper fittings with soldered joints.
- D. Safety-Relief-Valve Discharge Piping: Copper, Type K (A) annealed or drawn-temper tubing and wrought-copper fittings and brazed joints.
- E. Safety-Relief-Valve Discharge Piping:
 - 1. NPS 5/8 (DN 18) and Smaller: Copper, Type L (B), annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
 - 2. NPS 3/4 to NPS 1 (DN 20 to DN 25) and Smaller: Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.
 - 3. NPS 1-1/4 (DN 32) and Smaller: Copper, Type K (A) drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.
 - 4. NPS 1-1/2 to NPS 2 (DN 40 to DN 50) Copper, Type K (A), drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.
- F. Safety-Relief-Valve Discharge Piping NPS 2 to NPS 4 (DN 50 to DN 100): Schedule 40, black-steel and wrought-steel fittings with welded joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install diaphragm packless valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- E. Install a full-size, three-valve bypass around filter dryers.

- F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by 2010 ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:
 - 1. Solenoid valves.
 - 2. Thermostatic expansion valves.
 - 3. Hot-gas bypass valves.
 - 4. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve.
- L. Install receivers sized to accommodate pump-down charge.
- M. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection.
- L. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- M. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- N. No Steel refrigerant piping.
- O. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- P. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

- S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.4 PIPE 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 pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.
- F. Threaded Joints: Thread steel 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 to 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. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.
- H. Welded Joints: Construct joints according to AWS D10.12M/D10.12.
- I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 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. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:
1. NPS 1/2: Maximum span, 60 inches; minimum rod, 1/4 inch.
 2. NPS 5/8: Maximum span, 60 inches; minimum rod, 1/4 inch.
 3. NPS 1: Maximum span, 72 inches; minimum rod, 1/4 inch.
 4. NPS 1-1/4: Maximum span, 96 inches; minimum rod, 3/8 inch.
 5. NPS 1-1/2: Maximum span, 96 inches; minimum rod, 3/8 inch.
 6. NPS 2: Maximum span, 96 inches; minimum rod, 3/8 inch.
 7. NPS 2-1/2: Maximum span, 108 inches; minimum rod, 3/8 inch.
- D. Support multi floor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
1. Comply with ASME B31.5, Chapter VI.
 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure.
 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.
- B. Prepare test and inspection reports.

3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 1. Open shutoff valves in condenser water circuit.
 2. Verify that compressor oil level is correct.
 3. Open compressor suction and discharge valves.
 4. Open refrigerant valves except bypass valves that are used for other purposes.
 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

SECTION 233113

METAL DUCTS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Section Includes:
 - 1. Single-wall rectangular ducts and fittings.
 - 2. Single-wall round ducts and fittings.
 - 3. Sheet metal materials.
 - 4. Duct liner.
 - 5. Sealants and gaskets.
 - 6. Hangers and supports.

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 shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
- B. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.
 - 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
 - 4. Elevation of top of ducts.
 - 5. Dimensions of main duct runs from building grid lines.
 - 6. Fittings.
 - 7. Reinforcement and spacing.
 - 8. Seam and joint construction.
 - 9. Penetrations through fire-rated and other partitions.
 - 10. Equipment installation based on equipment being used on Project.
 - 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 - 12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 - 2. Suspended ceiling components.
 - 3. Structural members to which duct will be attached.

4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. 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 2-1, "Rectangular Duct/Transverse 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 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- 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 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse 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."
 - 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 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger than 90 inches in diameter 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 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 DOUBLE-WALL ROUND DUCTS AND FITTINGS

- A. Subject to compliance with requirements, provide products by one of 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 3-1, "Round Duct Transverse 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."
 - 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 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - a. Fabricate round ducts larger than 90 inches in diameter 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 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "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 sheet steel.

2.4 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 1. Galvanized Coating Designation: G60.
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. 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.
- D. 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.
- E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.5 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 1. Subject to compliance with requirements, the following manufacturers are approved.
 - a. Johns Manville.
 - b. Knauf Insulation.
 - c. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature when tested according to ASTM C 518.
 3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to ASTM E 84; certified by an NRTL.
 4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
 - a. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 3. Butt transverse joints without gaps, and coat joint with adhesive.
 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
 6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
 7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
 8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.

- c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
 - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.6 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 1. Sealant: Modified styrene acrylic.
 2. Water resistant.
 3. Mold and mildew resistant.
 4. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 5. Service: Indoor and outdoor.
 6. Service Temperature: Minus 40 to plus 200 deg F.
 7. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 9. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

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.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. VOC: Maximum 395 g/L.
12. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
13. Service: Indoor or outdoor.
14. 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, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.7 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials

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 all ducts to Seal Class 'A' according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 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 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

B. Leakage Tests:

1. Leak test each ductwork system within ten (10) working days of ductwork installation, and before ductwork is insulated or concealed.
2. Leak-test all ductwork. Follow general procedures (Chapter 3) and use apparatus (Chapter 5) as outlined in the referenced SMACNA HVAC Air Duct Leakage Test Manual.
3. Duct construction pressure classifications for ductwork are indicated in this Section. Test ductwork at 100 percent of the pressure classifications indicated.
4. Include devices, including access doors, airflow measuring devices, sound attenuators, damper casings, sensors and test ports, that are installed in duct systems as part of the duct systems leakage allowance and test accordingly. Air leakage for equipment, such as fans, air handling units and terminal boxes, has been accounted for separately and equipment has been specified to meet specific air leakage criteria. Independently leak test equipment to assure compliance with requirements and isolate this equipment during ductwork leak testing. As an alternate, leak-test equipment as part of duct system, if this is noted on report forms and that leakage rate allowances for ductwork and equipment are identified separately on forms.
5. If tests show that ductwork leakage is greater than that allowed, reseal/reweld and retest ductwork until within allowable leakage. Perform rework at no additional cost. Tests will be witnessed and results verified by Owner's Representative and the independent Testing and Balancing Agency. Submit field test report certifying that the ductwork does not exceed the maximum allowable leakage.

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.

3.8 DUCT CLEANING

- A. Clean new duct systems 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 Section 233300 "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.

3.9 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units and Downstream of Terminal Units:

a. Pressure Class: Positive 1-inch wg.

2. Ducts Between Air-Handling Units and Smoke Dampers:

a. Pressure Class: Positive 12-inch wg.

3. Stair Tower Pressurization Ducts and Ducts Between Smoke Damper and Variable Volume Boxes:

a. Pressure Class: Positive 4-inch wg.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units and Terminal Units:

a. Pressure Class: Positive or negative 1-inch wg.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Negative 2-inch wg.

D. Exhaust Ducts:

1. Ducts Connected to Toilet, Dryer and Shower Exhaust Air:

- a. Pressure Class: Negative 3-inch wg.
 2. Smoke Exhaust Ducts and Ducts Connected to Relief Air from Air-Handling Units:
 - a. Pressure Class: Positive 2-inch wg.
- E. Outdoor-Air Ducts:
1. Ducts Connected to Fan Coil Units and Terminal Units:
 - a. Pressure Class: Positive or negative 1-inch wg.
 2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
- F. Transfer Ducts:
1. All locations:
 - a. Pressure Class: Negative 0.5-inch wg.
- G. Allowable Duct Leakage Rates (Ductwork Only):
1. Each Supply, Outside, Return and Exhaust Air System: 3 percent of schedules airflow.
 2. Transfer Ducts: No leakage testing required.
- H. Intermediate Reinforcement:
1. Galvanized-Steel Ducts: Galvanized steel.
 2. Aluminum Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Galvanized.
- I. Liner:
1. Supply and Transfer Air Ducts: Fibrous glass, Type I, 1 inch thick.
 2. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.

J. 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.

K. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "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 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "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) 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: Standing seam.

END OF SECTION

SECTION 233300
AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Section Includes:
 - 1. Backdraft and pressure relief dampers.
 - 2. Manual volume dampers.
 - 3. Control dampers.
 - 4. Fire dampers.
 - 5. Smoke dampers.
 - 6. Combination fire and smoke dampers.
 - 7. Flange connectors.
 - 8. Turning vanes.
 - 9. Duct-mounted access doors.
 - 10. Flexible connectors.
 - 11. Flexible ducts.
 - 12. Duct accessory hardware.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- 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, combination fire- and smoke-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
- e. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- 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 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.

2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.
- C. 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.
- D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 APPROVED MANUFACTURERS – DAMPERS

- A. The following manufacturers are approved for all types of dampers described below.

1. Air Balance.
2. American Warming and Ventilating.
3. Cesco.
4. Greenheck.
5. Ruskin.
6. Lloyd.

2.4 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Description: Gravity balanced.
- B. Maximum Air Velocity: 1000 fpm.
- C. Maximum System Pressure: 1-inch wg.
- D. Blades: Multiple single-piece blades, maximum 6-inch width, noncombustible, tear-resistant, neoprene-coated fiberglass with sealed edges.
- E. Blade Action: Parallel.
- F. Blade Seals: Neoprene, mechanically locked.
- G. Return Spring: Adjustable tension.

2.5 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 1. Standard leakage rating, with linkage outside airstream.
 2. Suitable for horizontal or vertical applications.
 3. Frames:
 - a. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 4. Blades:
 - a. Multiple blade.
 - b. Opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch thick.

5. Tie Bars and Brackets: Galvanized steel.

2.6 CONTROL DAMPERS

A. Frames:

1. Angle shaped.
2. 0.094-inch- thick, galvanized sheet steel.
3. Mitered and welded corners.

B. Blades:

1. Multiple blade with maximum blade width of 6 inches.
2. Opposed-blade design.
3. Galvanized-steel.
4. 0.064 inch thick single skin or 0.0747-inch- thick dual skin.
5. Blade Edging: Closed-cell neoprene.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

C. 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.

D. Bearings:

1. 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.
2. Thrust bearings at each end of every blade.

2.7 FIRE DAMPERS

- A. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.
- B. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- C. Fire Rating: 1-1/2 hours.
- D. Frame: Curtain type with blades outside airstream (Type C); 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: 0.05 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, 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: Electric, resettable link and switch package, factory installed, 165 deg F and 212 deg F rated.

2.8 SMOKE DAMPERS

- A. General Requirements: Label according to UL 555S by an NRTL.
- B. Smoke Detector: Integral, factory wired for single-point connection.
- C. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel, with welded corners and mounting flange.
- D. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel.

- E. Leakage: Class I.
- F. Rated pressure and velocity to exceed design airflow conditions.
- G. Mounting Sleeve: Factory-installed, 0.039-inch- thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone caulking.
- H. Damper Motors: Modulating or two-position action.
- I. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.
 - 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 Section 230923 "Building Automation System (BAS) for HVAC".
 - 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.
- J. Accessories:
 - 1. Auxiliary switches for signaling and position indication.
 - 2. Momentary test switch, mounted.

2.9 COMBINATION FIRE AND SMOKE DAMPERS

- A. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

- B. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- C. Fire Rating: 1-1/2 hours.
- D. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel, with welded corners and mounting flange.
- E. Heat-Responsive Device: Replaceable, 212 deg F rated, fusible links.
- F. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.
- G. Smoke Detector: Integral, factory wired for single-point connection.
- H. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel.
- I. Leakage: Class I.
- J. Rated pressure and velocity to exceed design airflow conditions.
- K. Mounting Sleeve: Factory-installed, 0.05-inch- thick, galvanized sheet steel; length to suit wall or floor application.
- L. Master control panel for use in dynamic smoke-management systems.
- M. Damper Motors: two-position action.
- N. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "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 Section 230923 "Building Automation System (BAS) for HVAC."
 - 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.

O. Accessories:

1. Auxiliary switches for remote monitoring of damper position.
2. Test and reset switches, damper mounted.

2.10 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Ductmate Industries, Inc.
 2. Nexus PDQ; Division of Shilco Holdings Inc.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.11 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, the following manufacturers are approved.

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. METALAIRE, Inc.
5. SEMCO Incorporated.
6. 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 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- E. Vane Construction: Double wall.
- F. Shop-fabricated turning vanes are not permitted.

2.12 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, the following manufacturers are approved.
1. American Warming and Ventilating; a division of Mestek, Inc.
 2. Cesco Products; a division of Mestek, Inc.
 3. Ductmate Industries, Inc.
 4. Elgen Manufacturing.
 5. Flexmaster U.S.A., Inc.
 6. Greenheck Fan Corporation.
 7. McGill AirFlow LLC.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - 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: Continuous and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Continuous 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 3.0- to 8.0-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.

2.13 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, the following manufacturers are approved.
1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Elgen Manufacturing.
 4. Ventfabrics, Inc.
 5. 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 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd.
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: 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. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.

2.14 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, the following manufacturers are approved.
 - 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, aluminum laminate and polyester film with latex adhesive 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 20 to plus 210 deg F.
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

C. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
2. Non-Clamp Connectors: Liquid adhesive plus tape.

2.15 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.

2.16 SOUND ATTENUATORS

- A. Products of indicated manufacturers are acceptable.
 1. Industrial Acoustics Company (IAC).
 2. Commercial Acoustics.
 3. Ruskin Sound Control.
 4. Vibro-Acoustics.
 5. VAW Systems.
- B. Products, unless otherwise indicated, shall have a composite fire and smoke rating, when tested in accordance with ASTM E84, NFPA 255 or UL 723 test procedures, not to exceed Flame Spread of 25 and Smoke Developed of 50.
- C. Lining and adhesive shall be odorless.
- D. Materials shall not support mold growth.
- E. Filled Sound Attenuators:
 1. Shop-fabricate of galvanized steel to match the construction and pressure classification of adjoining duct or casing, of incombustible materials, and be a manufacturer's standard product. Design the sound attenuators for a differential pressure of 8 inches w.g., both positive and negative. Filler materials shall be inert, and vermin- and moisture-proof. Provide a polyethylene moisture and particulate barrier between perforated metal panels and sound-attenuating filler material.

2. Unless otherwise indicated, the types of sound attenuators specified in the following paragraphs are the products of Industrial Acoustics Company (IAC). Equivalent products of the other approved manufacturers listed above are acceptable.
3. Minimum dynamic net insertion loss performance (dB ref: 10-12 Watts) in octave bands for each designated sound attenuator shall be as listed below as representative for 24 inch by 24 inch rectangular and 36 inch conical attenuators:

Length (feet)	Face Velocity (fpm)	Flow	Dynamic Net Insertion Loss in dB				Maximum Pressure Drop (inches w.g.)	IAC Type
			2nd	3rd	4th	5th		
6	3,000	(+)	13	18	34	35	0.55	CS
5	2,000	(-)	8	14	23	31	0.22	L

(+) Noise and Air Same Direction (Forward Flow)

(-) Noise and Air Opposite Direction (Reverse Flow)

4. Maximum self-generated noise (dB ref: 10-12 Watts) by the foregoing attenuator types shall not exceed the following sound power levels for the representative attenuators listed below:

IAC Type	Face Velocity (fpm)	Self-Generated Noise Sound Power Levels in Decibels			
		2nd	3rd	4th	5th
C _S	3,000(+)	60	57	57	57
L	2,000(-)	52	52	53	56

(+) Noise and Air Same Direction (Forward Flow)

(-) Noise and Air Opposite Direction (Reverse Flow)

5. Submit certification of net insertion loss in dB and pressure drop in inches w.g. The net insertion loss shall be obtained for the airflow velocities scheduled.
- F. Submit dynamic net insertion loss and static pressure drop data for indicated airflow as obtained in accordance with ASTM E 477.

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/control 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 and smoke dampers according to UL listing.
- H. 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.
- I. Install access doors with swing against duct static pressure.
- J. 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.
- K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- N. Connect diffusers to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- O. Install duct test holes where required for testing and balancing purposes.
- P. Where multiple attenuator units are grouped together in parallel to obtain velocities and pressure drops as indicated within the duct system or air handling unit, seal upstream and downstream joints airtight with sealant.
- Q. Provide transition sections between attenuators and connecting ductwork.

- R. Insulate attenuators in accordance with Section 230713 with the same material and thickness as the adjacent ductwork or AHU casing.

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.

END OF SECTION

SECTION 233416
CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Section Includes: For each product.
 - 1. Backward-inclined centrifugal fans.
- B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018110, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design Fan supports to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Wind-Restraint Performance: Refer to Structural DWGs for design criteria.

1.4 ACTION SUBMITTALS

- A. Product Data:

1. Include rated capacities, furnished specialties, and accessories for each fan.
2. Certified fan performance curves with system operating conditions indicated.
3. Certified fan sound-power ratings.
4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
5. Material thickness and finishes, including color charts.
6. Dampers, including housings, linkages, and operators.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. 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. Delegated-Design Submittal: For Fan 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 curb to roof structure. Indicate coordinating requirements with roof membrane system.
2. Wind-Restraint Details: Detail fabrication and attachment of wind and seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Belts: Two set(s) for each belt-driven unit.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 BACKWARD-INCLINED CENTRIFUGAL FANS

- A. Basis-of-Design Product: Subject to compliance with requirements, the following manufacturers are approved.

1. Greenheck CSW.
2. PennBarry.
3. Loren Cook Company.
4. New York Blower Company (The).

- B. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
3. Factory-installed and -wired disconnect switch, suitable for outdoor locations.

- C. Housings:

1. Formed panels to make curved-scroll housings with shaped cutoff.
2. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.

3. Horizontally split, bolted-flange housing.
4. Spun inlet cone with flange.
5. Outlet flange.

D. Backward-Inclined Wheels:

1. Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades, and fastened to shaft with set screws.
2. Welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate.

E. Shafts:

1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

F. Prelubricated and Sealed Shaft Bearings:

1. Self-aligning, pillow-block-type ball bearings.
2. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
3. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.

G. Grease-Lubricated Shaft Bearings:

1. Self-aligning, pillow-block-type, tapered roller bearings with double-locking collars and two-piece, cast-iron housing.
2. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
3. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.

H. Grease-Lubricated Shaft Bearings:

1. Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
2. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
3. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.

I. Belt Drives:

1. Factory mounted, with adjustable alignment and belt tensioning.
2. Service Factor Based on Fan Motor Size: 1.5.
3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
5. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
6. Motor Mount: Adjustable for belt tensioning.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.4 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210/ASHRAE 51, "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install centrifugal fans level and plumb.
- B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

- D. Equipment Mounting:
 - 1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration Controls for HVAC Piping and Equipment." Vibration Isolators: Spring isolators having a static deflection of 1.5 inches.
- E. Install roof-mounted fans on curb on structure, level and secure, according to "The NRCA Roofing and Waterproofing Manual," Low-Slope Membrane Roofing Construction Details Section, Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install and secure centrifugal fans on curbs, and coordinate roof penetrations and flashing with roof construction. Secure units to curb support with anchor bolts.
- F. Unit Support: Install centrifugal fans level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure units to structural support with anchor bolts.
- G. Isolation Curb Support: Install roof-mounted fans on isolation curbs, and install vibration isolation devices.
 - 1. Comply with requirements in Section 233300 "Air Duct Accessories" for flexible duct connectors.
 - 2. Comply with requirements in Section 230548 "Vibration Controls for HVAC Piping and Equipment" for vibration isolation and seismic-control devices. Vibration Isolators: Spring isolators having a static deflection of 1.5 inches.
- H. Install units with clearances for service and maintenance.
- I. Label fans according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."
- B. Install ducts adjacent to fans to allow service and maintenance.
- C. Install piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain with pipe sizes matching the drain connection.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 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. See Section 230593 "Testing, Adjusting, and Balancing For HVAC" for testing, adjusting, and balancing procedures.
 - 10. Remove and replace malfunctioning units and retest as specified above.
- C. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.
- D. 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 centrifugal fans.

END OF SECTION

SECTION 233713

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Section Includes:
 - 1. Rectangular and square ceiling diffusers.
 - 2. Fixed face grille.
 - 3. Linear slot diffusers.
 - 4. Louver face diffusers.
 - 5. Linear bar diffusers.

1.3 ACTION 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: Of finish and color for selection and approval.

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 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.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Round Ceiling Diffuser :

1. Manufacturers: Subject to compliance with requirements, the following manufacturers are approved.
 - a. Anemostat Products; a Mestek company.
 - b. Carnes.
 - c. Price Industries.
 - d. Titus.
 - e. Tuttle & Bailey.
2. Devices shall be specifically designed for constant-air-volume flows.
3. Material: Steel.
4. Face Style: Three cone.
5. Mounting: Duct connection.

B. Rectangular and Square Ceiling Diffusers:

1. Manufacturers: Refer to Article 2.1.
2. Devices shall be specifically designed for constant-air-volume flows.
3. Material: Steel.
4. Face Size: See schedules.
5. Mounting: Refer to reflected ceiling plans on the architectural contract drawings.

6. Pattern: See schedules.
7. Accessories:
 - a. 24 inch by 24 inch mounting panel.
- C. Provide each diffuser collar with an adjustable grid designed to distribute the air evenly over the entire face of the outlet with an adjustable volume damper and operating mechanism.
- D. Provide blank-off baffles in diffusers or diffuser cores with blow patterns to shield nearby obstructions in the diffuser air path.
- E. Louvered Face Diffusers: Diffusers shall be of the jet-induction, air-mixing type, assembled in combinations of louver sections arranged to discharge air from each side in quantities proportional to the area served. Between the louvers, diffusing vanes shall extend to the diffuser face to compress the air jets to induce room air. Jets from adjacent channels shall discharge in opposite directions to ensure rapid mixing of primary and room air. Weld diffuser louvers and vanes to prevent tampering. Approved Models: Titus TDV, Tuttle and Bailey RC with removable core, Price, Anemostat, Carnes SKV.
- F. Perforated Face Diffuser With Square or Rectangular Neck: Provide square to round adapter as required for round connection to ductwork. Provide rectangular perforated face diffusers with adjustable pattern cores for one-, two-, three- and four-way air discharge or exhaust service as indicated on the drawings, with each side delivering a quantity of air proportional to the area served. Deflector cores shall not restrict the neck or face of the diffuser. The diffuser face shall be removable and secured by a concealed fastening system. Construct the perforated face of rustproof sheet steel. Approved Models: Tuttle and Bailey Model PB, Titus PAS-3, Price, Anemostat, Carnes SPABW.

2.2 CEILING LINEAR SLOT OUTLETS

- A. Linear Slot Diffuser (Supply and Return):
 1. Manufacturers: Refer to Article 2.1.
 2. Devices shall be specifically designed for variable-air-volume flows.
 3. Material - Shell: Steel.
 4. Material - Pattern Controller and Tees: Aluminum.
 5. Finish - Face and Shell: Baked enamel, color selected by Architect.
 6. Finish - Pattern Controller: Baked enamel, color selected by Architect.
 7. Finish - Tees: Baked enamel, color selected by Architect.
 8. Slot Width: 1 inch.
 9. Number of Slots: As scheduled.
 10. Length: As scheduled for active length, coordinate with RCP for blank offs and unused sections.

2.3 REGISTERS AND GRILLES

A. Adjustable Bar Register:

1. Manufacturers: Refer to Article 2.1.
2. Material: Steel.
3. Face Blade Arrangement: Horizontal.
4. Core Construction: Integral.
5. Rear-Blade Arrangement: Vertical.
6. Damper Type: Adjustable opposed blade.
7. Accessories:
 - a. Front & Rear-blade gang operator.

B. Fixed Face Grille:

1. Manufacturers: Refer to Article 2.1.
2. Material: Steel.
3. Face Arrangement: 1/2-by-1/2-by-1/2-inch grid core.
4. Core Construction: Integral.
5. Mounting: Countersunk screw.

C. Linear Bar Grille:

1. Manufacturers: Refer to Article 2.1.
2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Aluminum.
4. Finish: Baked enamel, color selected by Architect.
5. Wide Core Spacing Arrangement: 3/16-inch-thick blades spaced 1/2 inch apart, 30-degree deflection.
6. Frame: selected by Architect.
7. Mounting: Concealed bracket.
8. Damper Type: Adjustable opposed-blade assembly.

2.4 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Support independently of the ceiling construction and in a way that they cannot swing down. If using two (2) support hangers, place them at diagonal corners.
- B. Review the Architectural Contract Documents describing the types of walls, floors and ceilings required coordinate with other trades, and for selecting the proper type of frame and mounting for each air terminal.
- C. Install diffusers, registers, and grilles level and plumb.
- D. 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 Owner for a determination of final location.
- E. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 235123

GAS VENTS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SUMMARY

- A. Section Includes:
 - 1. Listed double-wall vents.

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 product.
- B. Shop Drawings: For vents.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Detail fabrication and assembly of hangers and seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

- B. Sample Warranty: For special warranty.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents.
- B. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

PART 2 - PRODUCTS

2.1 LISTED TYPE B AND BW VENTS

- A. Approved Manufacturers.
 - 1. Schebler.
 - 2. Selkirk
 - 3. Metal-Fab.
- B. Description: Double-wall metal vents tested according to UL 441 and rated for 480 deg F continuously for Type B or 550 deg F continuously for Type BW; with neutral or negative flue pressure complying with NFPA 211.
- C. Construction: Inner shell and outer jacket separated by at least a 1/4-inch airspace.
- D. Inner Shell: ASTM A 666, Type 430 stainless steel.
- E. Outer Jacket: Galvanized steel.
- F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.
 - 1. Termination: Stack cap designed to exclude minimum 90 percent of rainfall.

2. Termination: Round chimney top designed to exclude minimum 98 percent of rainfall.
3. Termination: Exit cone with drain section incorporated into riser.
4. Termination: Antibackdraft.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 APPLICATION

- A. Listed Type B and BW Vents: Vents for certified gas appliances.

3.3 INSTALLATION OF LISTED VENTS

- A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."
- B. Comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.
- C. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.
- D. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.
- E. Lap joints in direction of flow.

3.4 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

END OF SECTION

SECTION 238126

SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. For Compressor: Five year(s) from date of Substantial Completion.
 - b. For Parts: Five year(s) from date of Substantial Completion.
 - c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Mitsubishi
- B. Daikin
- C. York

2.2 INDOOR UNITS (5 TONS OR LESS)

A. Concealed Evaporator-Fan Components:

1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
2. Insulation: Faced, glass-fiber duct liner.
3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
4. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
5. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
7. Filters: Permanent, cleanable.
8. Condensate Drain Pans:
 - a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

- 1) Depth: A minimum of 2 inches deep.
 - b. Single-wall, stainless-steel sheet or plastic.
 - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
 - 1) Minimum Connection Size: NPS 1”.
 - d. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
- B. Floor-Mounted, Evaporator-Fan Components:
1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect.
 - a. Discharge Grille: Steel with surface-mounted frame.
 - b. Insulation: Faced, glass-fiber duct liner.
 - c. Drain Pans: Stainless steel or plastic, with connection for drain; insulated.
 2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
 3. Fan: Direct drive, centrifugal.
 4. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
 5. Air Filtration Section:
 - a. General Requirements for Air Filtration Section:
 - 1) Comply with NFPA 90A.
 - 2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.

- 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
- b. Disposable Panel Filters:
 - 1) Factory-fabricated, viscous-coated, flat-panel type.
 - 2) Thickness: 1 inch .
 - 3) Initial Resistance: 0.3 inches wg.
 - 4) Recommended Final Resistance: 0.6 inches wg.
 - 5) Arrestance according to ASHRAE 52.1: 80.
 - 6) Merv according to ASHRAE 52.2: 12.
 - 7) Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
 - 8) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.
- c. Extended-Surface, Disposable Panel Filters:
 - 1) Factory-fabricated, dry, extended-surface type.
 - 2) Thickness: 1 inch.
 - 3) Initial Resistance: 0.3 inches wg.
 - 4) Recommended Final Resistance: 0.6 inches wg.
 - 5) Arrestance according to ASHRAE 52.1: 90.
 - 6) Merv according to ASHRAE 52.2: 12.
 - 7) Media: Fibrous material formed into deep-V-shaped pleats with antimicrobial agent and held by self-supporting wire grid.
 - 8) Media-Grid Frame: Nonflammable cardboard.
 - 9) Mounting Frames: Welded, galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.
- C. Wall-Mounted, Evaporator-Fan Components:
 1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
 2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
 3. Fan: Direct drive, centrifugal.
 4. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.

- c. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
 - d. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
- 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- 6. Condensate Drain Pans:
 - a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
 - 1) Depth: A minimum of 1 inch deep.
 - b. Single-wall, stainless-steel sheet or plastic.
 - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
 - 1) Minimum Connection Size: NPS 1”.
- 7. Air Filtration Section:
 - a. General Requirements for Air Filtration Section:
 - 1) Comply with NFPA 90A.
 - 2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.

- 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

b. Disposable Panel Filters:

- 1) Factory-fabricated, viscous-coated, flat-panel type.
- 2) Thickness: 1 inch.
- 3) Initial Resistance: 0.3 inches wg.
- 4) Recommended Final Resistance: 0.6 inches wg.
- 5) Arrestance according to ASHRAE 52.1: 80.
- 6) Merv according to ASHRAE 52.2: 12.
- 7) Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
- 8) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

c. Extended-Surface, Disposable Panel Filters:

- 1) Factory-fabricated, dry, extended-surface type.
- 2) Thickness: 1 inch.
- 3) Initial Resistance: 0.3 inches wg.
- 4) Recommended Final Resistance: 0.6 inches wg.
- 5) Arrestance according to ASHRAE 52.1: 90.
- 6) Merv according to ASHRAE 52.2: 12.
- 7) Media: Fibrous material formed into deep-V-shaped pleats with antimicrobial agent and held by self-supporting wire grid.
- 8) Media-Grid Frame: Nonflammable cardboard.
- 9) Mounting Frames: Welded, galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

2.3 OUTDOOR UNITS (5 TONS (18 kW) OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - a. Compressor Type: Scroll.
 - b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.

- c. Refrigerant Charge: R-410A.
 - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
- 3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
 - 4. Fan: Aluminum-propeller type, directly connected to motor.
 - 5. Motor: Permanently lubricated, with integral thermal-overload protection.
 - 6. Mounting Base: Polyethylene.

2.4 ACCESSORIES

- A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- D. Drain Hose: For condensate.

2.5 CAPACITIES AND CHARACTERISTICS

- A. Cooling Capacity:
 - 1. Per the schedules.

- B. Indoor Unit:
 - 1. Per the Schedules
- C. Outdoor Unit:
 - 1. Per the Schedules

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Equipment Mounting:
 - 1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified.
 - 2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
 - 3. Comply with requirements for vibration isolation devices specified in Section 230548 "Vibration Controls for HVAC."
- E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 238126
SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
1. Warranty Period:
 - a. For Compressor: Five year(s) from date of Substantial Completion.
 - b. For Parts: Five year(s) from date of Substantial Completion.
 - c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Mitsubishi
- B. Daikin
- C. York

2.2 INDOOR UNITS (5 TONS OR LESS)

- A. Concealed Evaporator-Fan Components:
1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
 2. Insulation: Faced, glass-fiber duct liner.
 3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
 4. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
 5. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
 6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
 7. Filters: Permanent, cleanable.
 8. Condensate Drain Pans:

- a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
 - 1) Depth: A minimum of 2 inches deep.
 - b. Single-wall, stainless-steel sheet or plastic.
 - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
 - 1) Minimum Connection Size: NPS 1".
 - d. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
- B. Floor-Mounted, Evaporator-Fan Components:
1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect.
 - a. Discharge Grille: Steel with surface-mounted frame.
 - b. Insulation: Faced, glass-fiber duct liner.
 - c. Drain Pans: Stainless steel or plastic, with connection for drain; insulated.
 2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
 3. Fan: Direct drive, centrifugal.
 4. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
 5. Air Filtration Section:
 - a. General Requirements for Air Filtration Section:
 - 1) Comply with NFPA 90A.
 - 2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
 - 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
 - b. Disposable Panel Filters:
 - 1) Factory-fabricated, viscous-coated, flat-panel type.
 - 2) Thickness: 1 inch .
 - 3) Initial Resistance: 0.3 inches wg.
 - 4) Recommended Final Resistance: 0.6 inches wg.
 - 5) Arrestance according to ASHRAE 52.1: 80.

- 6) Merv according to ASHRAE 52.2: 12.
- 7) Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
- 8) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

c. Extended-Surface, Disposable Panel Filters:

- 1) Factory-fabricated, dry, extended-surface type.
- 2) Thickness: 1 inch.
- 3) Initial Resistance: 0.3 inches wg.
- 4) Recommended Final Resistance: 0.6 inches wg.
- 5) Arrestance according to ASHRAE 52.1: 90.
- 6) Merv according to ASHRAE 52.2: 12.
- 7) Media: Fibrous material formed into deep-V-shaped pleats with antimicrobial agent and held by self-supporting wire grid.
- 8) Media-Grid Frame: Nonflammable cardboard.
- 9) Mounting Frames: Welded, galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

C. Wall-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Fan: Direct drive, centrifugal.
4. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - c. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
 - d. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
6. Condensate Drain Pans:
 - a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
 - 1) Depth: A minimum of 1 inch deep.
 - b. Single-wall, stainless-steel sheet or plastic.
 - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

- 1) Minimum Connection Size: NPS 1".

7. Air Filtration Section:

a. General Requirements for Air Filtration Section:

- 1) Comply with NFPA 90A.
- 2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
- 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

b. Disposable Panel Filters:

- 1) Factory-fabricated, viscous-coated, flat-panel type.
- 2) Thickness: 1 inch.
- 3) Initial Resistance: 0.3 inches wg.
- 4) Recommended Final Resistance: 0.6 inches wg.
- 5) Arrestance according to ASHRAE 52.1: 80.
- 6) Merv according to ASHRAE 52.2: 12.
- 7) Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
- 8) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

c. Extended-Surface, Disposable Panel Filters:

- 1) Factory-fabricated, dry, extended-surface type.
- 2) Thickness: 1 inch.
- 3) Initial Resistance: 0.3 inches wg.
- 4) Recommended Final Resistance: 0.6 inches wg.
- 5) Arrestance according to ASHRAE 52.1: 90.
- 6) Merv according to ASHRAE 52.2: 12.
- 7) Media: Fibrous material formed into deep-V-shaped pleats with antimicrobial agent and held by self-supporting wire grid.
- 8) Media-Grid Frame: Nonflammable cardboard.
- 9) Mounting Frames: Welded, galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

2.3 OUTDOOR UNITS (5 TONS (18 kW) OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - a. Compressor Type: Scroll.
 - b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
 - c. Refrigerant Charge: R-410A.
 - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Mounting Base: Polyethylene.

2.4 ACCESSORIES

- A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- D. Drain Hose: For condensate.

2.5 CAPACITIES AND CHARACTERISTICS

- A. Cooling Capacity:
 1. Per the schedules.
- B. Indoor Unit:
 1. Per the Schedules
- C. Outdoor Unit:
 1. Per the Schedules

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.

- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Equipment Mounting:
 - 1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified.
 - 2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
 - 3. Comply with requirements for vibration isolation devices specified in Section 230548 "Vibration Controls for HVAC."
- E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units. Training shall be a minimum of 4 hours and shall be provided by a manufacturer's representative.

END OF SECTION 238126

**SECTION 26000
ELECTRICAL**

PART 1.00 – GENERAL

1.01 FILING OF SUB-BIDS

- A. Sub-bids for work under this Section shall be for the complete work and shall be filed in with the Awarding Authority at a time and method stipulated in the Bidding Requirements.
- B. All sub-bids shall be submitted on the Form for Sub-Bid furnished by the Awarding Authority, as required in Section 44F of Chapter 149 of the Massachusetts General Laws, as amended.
- C. Specific information relating to sub-bidders is set forth in the Bidding and Contract Documents and the Sub-bidders are directed thereto.
- D. Sub-bids filed with the Awarding Authority shall be accompanied by a Bid Bond issued by a responsible bank or trust company payable to the Town of Sharon in the amount of five percent of the Bid. A sub-bid accompanied by any other form of bid depository will be rejected.
- E. Work to be done under this Section is shown on the Drawings: E001, E002, ED100, E100, E200, E300, FA100
- F. Project Phasing specified in Section 011401 is part of the Work of
- G. The listing of Contract Drawings above shall not limit the Subcontractor's responsibility to determine the full extent of his work as required by all Contract Drawings.
- H. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- I. Examine all other Sections of the Specifications for requirements, which affect work under this Section whether or not such work is specifically mentioned in this Section.
- J. Sub Sub-Bid Requirements: (None required under this Section.)

1.02 GENERAL PROVISIONS

- A. Applicable provisions of "General Conditions" govern work under this section.
- B. The Electrical Contractor shall review all other sections of these Specifications for requirements therein affecting the work of this Section.
- C. The Electrical Contractor shall conform to all sections of these Specifications and Drawings.
- D. Contractor's duties for work specified below shall include compliance with all local and National Codes, Ordinances, Rules, Regulations, Orders, and all other requirements of Authorities, which bear on performance of work.

1.03 SCOPE OF WORK

- A. Furnish all labor, supervision, permits, certificates, materials, equipment, apparatus, accessories, supplies, tools, transportation, and services necessary for and incidental to, all electrical work as shown on the Drawings and/or specified hereinafter to the full completion of installation and operation of the intended electrical system.

- B. The principal items of work are as follows;
- B1: Items to be purchased and installed
1. Temporary Service
 2. Primary duct bank and Utility Company connections
 3. Secondary Power Service
 4. Telephone Service
 5. Grounding
 6. Main distribution equipment
 7. Power and lighting distribution panels
 8. Load centers
 9. Arc Flash/Coordination Study
 10. Lighting fixtures
 11. Lighting controls
 12. Safety switches
 13. Feeders to panels, load centers and equipment
 14. Wiring Devices
 15. Occupancy Sensors
 16. Branch circuit wiring
 17. Outlet boxes, receptacles, etc.
 18. Fire Stopping
 19. Telephone System
 20. Fire Alarm System
 21. Video Intercom system
 22. Audio-Visual Door Alert System
 23. All wiring connections to plumbing/electric water heater, heating & ventilating equipment, wherever required and as indicated on Drawings
 24. Voice/Data wiring
 25. Site Lighting
 26. All other systems, equipment and work hereinafter specified and/or shown on the Contract Drawings.
- B2 Items to be installed ONLY: Install the following items as furnished by the designated sections:
 Section 220000 (Plumbing): Connections to pumps aquastat for water heaters
 Section 230000 (HVAC): HVAC power connections to new equipment.
- C. It is the intent of the Specifications and the accompanying Drawings that the systems shall be furnished and installed complete. The Electrical Contractor shall furnish and install all conduit, wire, boxes, equipment, devices, and controls needed and usually furnished in connection with such work, whether specifically mentioned or not.
- D. The plans and specifications are complimentary to one another, and should the contractor discover a conflict between the plans and specifications or within the plans themselves the worst-case scenario shall prevail until the engineer and/or the architect provides direction.
- E. This Contractor shall refer to the Architectural, Civil, Landscape, Structural, Plumbing, Mechanical, Fire Protection Drawings and all other Drawings associated with the project, prior to the installation or roughing of the electrical outlets, conduit, and equipment to determine the exact location of all devices and equipment.

1.04 WORK NOT INCLUDED

- A. The following items of labor and material incidental too and/or related to the installation of the electrical work shall be provided and/or installed under other sections of the Specification.
 - 1. All cutting, patching, and furring.
 - 2. Painting of all equipment and material other than factory finished.
 - 3. Flashing
 - 4. Excavation and backfill.
 - 5. Concrete work.
 - 6. Mechanical control wiring unless otherwise indicated.

1.05 DEFINITIONS

- A. The “Electrical Contractor” specifically means, the Contractor working under this section for the specifications.
- B. “Furnish and install” or “provide” means to supply, erect, install and connect up complete, in readiness for regular operation, the particular work referred to unless otherwise specified.
- C. “Piping” includes, in addition to pipe, all fittings, boxes, hangers and other accessories relating to such piping.
- D. “Concealed” means hidden from sight, in chases, furred spaces, shafts, hung ceilings and embedded in construction.
- E. “Exposed” means visible in sight, not installed “concealed” as defined above.
- F. “Approved Equal” means any equipment or material which is equal in quality, durability, appearance, strength, design and performance to the equipment or material specified and which will function adequately in accordance with the general design and is approved by the engineer.

1.06 CODES AND STANDARDS

- A. Unless otherwise specified or indicated, materials and workmanship shall conform to the latest edition of the following Standards, Codes, specifications, Requirements and Regulations.
 - 1. National Electrical Code (NEC)
 - 2. State Electrical Code
 - 3. National Electrical Contractors Association. (NECA)
 - 4. National Electrical Manufacturer’s Association (NEMA)
 - 5. International Building Code (IBC)
 - 6. International Energy Conservation Code (IECC)
 - 7. Underwriters’ Laboratories, Inc. (UL)
 - 8. National Fire Protection Association (NFPA)
 - 9. Local Wiring Inspector
 - 10. Local Fire Marshall

11. All other State and Local Codes and/or Authorities having jurisdiction, including all other paragraphs of this Specification.

1.07 PERMITS AND FEES

- A. The Electrical Contractor shall secure and pay for all required permits and fess. All Utility Company back-charges shall be paid by the owner prior to work being started.
- B. The Electrical Contractor shall carry in his bid price and pay all costs incurred for, standard and special tests to be performed in conjunction with this Contract that are necessary for and incidental to, the accomplishment of his work and the use of work when completed.
- C. The Electrical Contractor shall, after completion, furnish to the General Contractor a Certificate of Final Inspection and Approval from the Local Electrical Inspection Department.

1.08 MATERIALS AND WORKMANSHIP

- A. Materials and workmanship shall be the best of their respective kinds and in full accordance with the most modern construction methods.
- B. Electrical materials and equipment of types for which there are Underwriters' Laboratories standard requirements, listings, or labels, shall conform to their requirements and be so labeled.

1.09 TESTS

- A. The right is reserved to conduct acceptance tests of all equipment, wiring, systems, or any other work furnished under these Drawings and/or Specifications to determine the fulfillment of specific requirements and/or design intent.
- B. The Electrical Contractor shall conduct all such tests in the presence of authorized representatives of the Owner and/or the architect of the engineer.
- C. The Electrical Contractor shall perform all tests, supply all instrumentation, personnel and make all adjustments of equipment and wiring as necessary. The Electrical Contractor, in the presence of the Owner's representative, shall take insulation resistance readings of all equipment and circuits. Megger readings of less resistance than the recommended minimum as called for by the National Electric Code shall be required or conductors shall be replaced by this Contractor at no cost to the Owner.

1.10 PORTABLE OR DETACHABLE PARTS

- A. The Electrical Contractor shall retain in his possession and shall be responsible for, all portable and/or detachable parts and portions of the installation, including fuses, keys, locks, adapters, blocking clips, inserts, lamp instructions, drawings and all other devices or materials that are relative to and necessary for the proper

operation and maintenance of all aspects of the electrical system until final completion of his work.

- B. The Electrical Contractor shall replace all stolen, lost, or damaged items relative to the installation and operation of the electrical system at his own expense before the building is accepted by the Owner.

1.11 PROTECTION AND CLEANING OF EQUIPMENT

- A. All electrical equipment, upon receipt, shall be adequately stored and protected from damage.
- B. After inspection, all electrical equipment shall be protected to prevent damage during the construction period. Openings in all conduits, raceways, fittings, and boxes shall be closed to prevent entrance of foreign materials.
- C. Before completion of work and before final inspection, all damaged and/or defective equipment and materials shall be replaced, and all exposed surfaces of electrical equipment shall be clean.
- D. Prior to acceptance by the owner the electrical contractor shall replace all defective lamps, and clean all exposed lighting fixture surfaces including but not limited to; reflectors, housings, exposed surfaces, etc.

1.12 DRAWINGS AND SPECIFICATIONS

- A. The Drawings (electrical, fire alarm, security, audio/visual, etc.) and these Specifications are complimentary to each other, and any labor or material called for by either, whether or not by both, necessary for the successful operation of any of the particular types of equipment or systems furnished under this Contract, shall be provided. Where a conflict arises between the plans and specifications or within the plans themselves, the worst-case scenario shall prevail unless directed otherwise by the engineer.
- B. Before installing any of the electrical work, see that it does not interfere with the clearances required for structural elements, finished columns, pilasters, partitions, or walls. Installed work, which interferes with other trades, shall be changed as directed by the Owner's representatives. All costs incidental to such changes shall be paid by the Electrical Contractor.

1.13 OBTAINING INFORMATION

- A. Obtain detailed information from the local utility company, telephone and cable television service providers, fire department, manufacturers of apparatus, which is to be furnished and installed, as to the proper method of installing and connecting same.
- B. Obtain all required design standards and information from the Owner's representative and other Subcontractors necessary to facilitate and complete the electrical work.
- C. Check all other Contract Drawings and all other sections of Contract Specifications for electrical equipment requiring connections and electrical characteristics of equipment should they differ from the Electrical Drawings.

1.14 SAFETY PRECAUTIONS

- A. The Electrical Contractor shall furnish, place, and maintain power guards and other necessary construction, required for the prevention of accidents to secure safety of life and/or property.

1.15 REMOVAL OF RUBBISH

- A. After completion of the work, the Electrical Contractor shall remove all waste, rubbish and other materials left because of his operations and leave the premises in clean condition.
- B. In addition to the cleaning up required in the Special Provisions, the Electrical Contractor shall, at the completion of the work, clean, polish, and/or wash all exposed items or materials, equipment, and fixtures in this Contact, so as to leave such items bright and clean.
- C. The Electrical Contractor shall repaint any painted metal surfaces, which have been scratched, dented, or marred.

1.16 COORDINATION OF TRADES

- A. The Electrical Contractor shall give full cooperation to other trades and shall furnish (in writing, with copies to Engineers) any information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.
- B. HVAC, Plumbing, and Electrical drawings are diagramatic.
- C. Where the work of the Electrical Contractor will be installed near work of other trades or where there is evidence that this Contractor will interfere with the work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the Designer, the Contractor shall prepare composite working Drawings and sections at a suitable scale not less than $\frac{1}{4}'' = 1'-0''$, clearly showing how his work is to be installed in relation to the work to correct the condition without extra charge. All cutting and patching, excavation and backfill shall be done by the General Contractor. The Contractor shall inform the General Contractor well in advance as to his requirements.
- D. The Electrical Contractor shall be responsible for phasing the electrical installation in accordance with the General Contractor and in coordination with other filed Sub-Bid contractors, and the construction schedule.
- E. All cutting and patching, excavation and backfill shall be done by the General Contractor. The Electrical Contractor shall inform the General Contractor well in advance as to his requirements.
- F. The electrical contractor shall be responsible for coordinating with the electric utility company, telephone service provider and cable television service provider to see that all the services and respective equipment to the building is installed and coordinated in a timely fashion.

1.17 VISITING THE SITE

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- A. The Electrical Contractor shall be required to visit the site and examine the existing conditions, which may affect his work under this Contract. Failure to do so shall be his responsibility and no claims for extra compensation or extension of time shall be allowed because of lack of compliance herewith.

1.18 FIELD MEASUREMENTS

- A. The Electrical Contractor shall verify in the field all measurements necessary for his work and shall assume responsibility for their accuracy.

1.19 GUARANTEE

- A. The Electrical Contractor guarantees by his acceptance of the Contract that all work installed will be free from all defects in workmanship and/or materials during period of one (1) year from date of Certificates of Completion and acceptance of work. If any such defects in workmanship or material appear, he will, without cost to the Owner, remedy such defects within a reasonable time.

1.20 SHOP DRAWINGS AND SAMPLES

- A. Before ordering material shipped to the job, the Electrical Contractor shall submit to the General Contractor for approval manufacturers references and bulletins, Shop Drawings, electronically, giving all details, dimensions, etc. of the following;
 - 1. Main service and Associated grounding in accordance with the utility company requirements
 - 2. Metering equipment and metering sequence in accordance with the utility company requirements
 - 3. Secondary duct bank arrangement
 - 4. Arc Flash/Coordination study
 - 5. Main Service equipment
 - 6. Main Distribution Panel, Panelboards, and Load centers
 - 7. Layout of the main and secondary electric rooms
 - 8. All lighting fixtures and lamps
 - 9. Network Interface panels
 - 10. Time Controllers
 - 11. Disconnect switches
 - 12. Fire Alarm equipment (all components)
 - 13. Bi-Directional Antenna system
 - 14. Building Cable, Wire, Conduit, and electrical commodities
 - 15. Cable Television System equipment and cable
 - 16. Tel/Data System equipment and wiring
 - 17. Wiring Devices (each type)
 - 18. Lighting Controls
 - 19. Video Intercom system
 - 20. Area of Rescue System

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- B. The Electrical Contractor shall also furnish samples of receptacles, light switches and other small parts as requested by the Architect.
- C. Should the Electrical Contractor choose to substitute for the specified equipment, the Shop drawing submittals must include catalog cuts of originally specified equipment. Shop Drawings submitted for approval without all the required information will not be considered for approval.

1.21 SUPERINTENDENCE OF WORK

- A. The Electrical Contractor shall give his personal superintendence to the work and shall retain at the job site during the period of construction, a competent Foreman, satisfactory to the Contractor, who shall be in full charge of the work under this section.

1.22 STORAGE OF MATERIALS

- A. The Electrical Contractor shall store his material and equipment before installation only where designated by the General Contractor. He shall be responsible for all his property stored on the premises and shall hold the General Contractor free from liability for loss by theft or carelessness of employees of the General contractor or of other Sub-Contractors. The Electrical Contractor shall take particular care to protect any finished work for injury or defacement and must remedy, at his expense, any injury caused thereto by his operations.

1.23 RECORD DRAWINGS

- A. The Electrical Contractor shall maintain at the site a set of black line prints on which shall be accurately shown the actual installation of work under this section of the specifications. The drawings shall indicate any variation, approved by the General contractor, from the Contract Drawings, including changes in sizes, locations, and dimensions. The Electrical Contractor shall deliver to the General Contractor for submittal to the Owner, a complete set of reproducible Record Drawings, showing the entire work as actually installed electronically.
- B. Operating instructions, and maintenance manual:
 - a. O&M data is to be provided for equipment supplied in an organized form.
 - b. Refer to contract provisions for submittal procedures pertaining to operating and maintenance data.

1.24 CONTRACT DRAWINGS

- A. The Contract Drawings are generally diagrammatic and are intended to convey the scope of work and indicate general arrangements of equipment, conduits, piping, and fixtures, wiring methods, etc.
- B. If directed by the General Contractor, the Electrical Contractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.
- C. All wiring device locations within dwelling units shall comply with the spacing requirements of Article 210 of the National Electrical Code whether shown on the

drawings or not. Reasonable modifications to the locations are acceptable due to structural framing and/or wall stud locations. All wiring devices shall be at least 24" from any corner throughout all the dwelling units and the remainder of the building.

1.25 TEMPORARY SERVICE

- A. Furnish and erect a suitable backboard for temporary meters and switches to measure and control current for testing, wiring, motors, and other appliances; for temporary lighting, machines or the apparatus used in the construction of the building, until such time as the permanent meter is installed. Furnish and mount on the temporary board, an approved service switch and do all necessary wiring to connect such circuits as required.
- B. Special heavy-duty circuits shall be paid for by the trade requiring same.
- C. Obtain city-wiring permit for the temporary wiring and pay all fees for same.

1.26 STAGING and SCAFFOLDING

- A. Subcontractor shall provide his own staging and scaffolding necessary to complete work.

PART 2.00 – PRODUCTS

2.01 RIGID STEEL CONDUIT

- A. All rigid steel conduits shall have a hot-dipped galvanized coat plus a secondary coat, galvanized threads, bear an Underwriters' Laboratories label and shall conform to Federal Specifications WW-C-581d and American Standards Association Specification C80.1. The conduit shall be fully threaded at both ends and each length shall be furnished with one standard threaded coupling. The use of thread-less conduit couplings and fittings will not be permitted. Threaded split couplings of the bolted clamp type are permitted. Rigid steel conduit shall be used for all power wiring where indicated.
- B. Galvanized rigid steel conduit sweeps, and quarter bends shall be installed at the pad mounted transformer and at the utility company poles. Each sweep to a pole shall extend ten feet up the pole with galvanized rigid steel conduit.
- C. Galvanized rigid steel conduit shall be installed where conduit needs to pass under roadways.
- D. All empty conduits shall be installed with Mule Tape that has sequential footage markings and 1800 lb. pulling strength.

2.02 ELECTRICAL METALLIC TUBING

- A. Electrical metallic tubing shall be Electro-galvanized outside and enameled inside. All electrical metallic tubing shall bear an Underwriters' Laboratories label and shall conform to Federal Specifications WW-C-563 and American Standards Association Specification C80-3.
- B. Couplings and fittings for EMT shall be of the compression type or setscrew type. EMT shall not be installed embedded in concrete, outdoors or in wet locations.

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- C. Any exposed wiring within the facility shall be installed in Electrical Metallic Tubing.
- D. Two (2), 4-inch EMT conduits shall be installed between the Main Distribution Frame (MDF) closet on the first floor and all satellite Intermediate Distribution Frame (IDF) closets for network connectivity.
- E. Conduit sleeves in the upper floors are required to allow cables to travel between stacked closets. Sleeves shall be fire stopped.
- F. EMT shall not have more than 3 – 90° bends or the equivalent of 270° in bends in any one run. Code compliant pill boxes shall be installed to ensure maintain this condition.
- G. EMT shall be securely fastened to building structure every 10'-0" on center and a support shall be installed within 3'-0" on any conduit body, pull box or outlet box.

2.03 FLEXIBLE METALLIC CONDUIT

- A. Flexible metal conduit shall be galvanized steel and shall contain an integral copper-grounding conductor. Liquid-tight flexible metal conduit shall be similar but shall also have an extruded moisture and oil-proof outer jacket of polyvinyl chloride plastic.
- B. Flexible metal conduit shall be utilized on all vibrating electrical equipment and shall be no greater than three feet in length.
- C. Liquid-tight flexible conduit shall be utilized on final connections to any outdoor equipment.

2.04 PVC CONDUIT

- A. Plastic conduit shall be PVC Schedule 40, iron pipe size, rigid polyvinylchloride equal to or better than ASTM Pipe Material ASTM PVC conduit Type 2, Grade 1, ASTM PVC 2110, Specification P-1785, Underwriters' Laboratory, Inc. approved for lengths beyond ten (10) feet shall be identical to the approved conduit. Where elbows are used, they shall be long radius type. PVC Conduit shall be manufactured by Kraloy, Barrett Division of Allied Chemical, Pittsburgh; Triangle Cable and Conduit Co., or approved equal.
- B. Schedule 40 PVC conduit shall be installed in concrete buried in earth as indicated on the drawings.
- C. PVC conduit shall be used to feed the site lighting fixtures.
- D. PVC conduits shall come in 10'-0" lengths and when multiple lengths are coupled together they shall be connected with a coupling and PVC glue.
- E. PVC Glue by Gorilla shall be non-flammable, low odor with no harmful fumes. The glue shall be fast acting to adhere to conduits and couplings and shall meet or exceed NSF, ASTM D-2564, IAPMO and R & T standards. The glue shall not require any primer require only the use of water for any spills or clean up.
- F. Conduits shall be installed as indicated on the drawings and all empty conduits shall be supplied with a ¼" nylon pull string. The pull string shall run the entire length of each conduit with at least 24 inches of slack at each end.
- G. All conduits entering or leaving a transformer, hand hole, manhole or any other enclosure shall be done with 22.5 degree sweeps and each sweep shall be provided with bell ends.

- H. All exposed exterior PVC conduits shall be equipped with expansion fitting.

2.05 WIREWAYS

- A. Totally enclosed sheet steel wireways, complete with all fittings, tees, elbows, wire retainers, closure plates, hangers, and component parts required for a complete installation shall be installed in all areas indicated on the Drawings and as required to facilitate the installation of the electrical systems.
- B. Physical size, length, and internal cross-sectional areas, of the wireways shall be determined in the field by the Electrical Subcontractor to suit field conditions unless noted otherwise on the Drawings.
- C. The wireway systems shall be constructed of code gauge galvanized sheet steel with hinged cover. Straight sections of the wireway system shall be constructed of two separate pieces of sheet steel. One piece shall be used to form the sides and top, the other to form the cover. Captive screws, furnished as a part of the wireway system, shall be used for sealing at all hinged covers and coupling at straight sections or fittings.
- D. All fittings, elbows, tees, and straight sections of the wireway shall be provided with smooth and round edges to protect the wiring from abrasion. All welded seams and joints shall be ground and polished to remove burred edges.
- E. A bonding jumper consisting of an insulated flexible #8 AWG copper conductor with soldered eyelet on each end shall be provided to bond and ground the wireway at each joining section of the wireway system. The bonding jumpers shall be attached to each section by means of a bolt, locknut, and washer. The Electrical Subcontractor shall remove the paint from the wireway at the contact points so that positive contact shall be made between the bare metals at each grounding point.
- F. The wireway system shall be provided with ½ inch and ¾ inch concentric knockouts every 6 inches on center along the top and ½ inch, ¾ inch, 1 inch, and 1-1/4 inches concentric knockouts every 6 inches along both sides.
- G. All sheet metal posts shall be factory primed with rust inhibiting phosphor coating and finished with USASI #24 dark gray enamel. All hardware shall be cadmium-plated to prevent rusting and corrosion.
- H. All lengths, connectors, and fittings of the wireway systems shall be UL approved and bear the Underwriters' Laboratories label. UL listing of lengths without listing of connectors and associated components or fittings shall not be acceptable.
- I. The wireway system, all component parts, and fittings, shall be by one manufacturer and shall be manufactured by Kelek, Lee Products, or Keystone.

2.06 OUTLET, PULL AND JUNCTION BOXES

- A. The locations of all wall switch boxes shall be coordinated with the Drawings and Project Manager before installation of same. All lighting control outlet boxes unless specifically noted otherwise on the Drawings shall be opposite the hinged side of the door for all single doors.
- B. The location of outlets shown on Drawings is approximate. The Electrical Contractor shall study the building plans in relation to the spaces and equipment surrounding each outlet, so that receptacles, switches, lighting fixtures, devices,

- or other electrical components are symmetrically located and mounted in or on the walls, ceiling, and floor. Spacing of the devices within the dwelling units shall be in accordance with Article 210 of the National Electrical Code and 521 CMR.
- C. Outlet, junction or pull boxes, shown on the Drawings, that interfere with the installation of mechanical equipment, structural or architectural features, or that will be inaccessible due to the work of other trades shall be relocated accordingly.
 - D. Outlet, junction or pull boxes that are not specifically shown on the Drawings but are required for the proper installation of the electrical system shall be installed by the Electrical Contractor, so that they do not interfere with the structural or architectural features and the installation of materials by the other trades.
 - E. Any reasonable change in the location of outlets, pull or junction boxes requested by the Architect, prior to roughing, shall not involve additional expense to the Owner.
 - F. All outlet, pull and junction boxes shall be installed in a rigid and satisfactory manner and shall be supported by bar hangers in frame constructions or shall be fastened directly with wood screws or 16 penny nails on wood, bolts with expansion shields on concrete or brick, toggle bolts on hollow masonry units and machine screws or welded threaded studs on metal. Threaded studs of the proper type and holding capacity driven in by a powder charge and provided with lock washers and nuts are acceptable for mounting of boxes on solid concrete walls or slabs. Preset inserts of the proper type and holding capacity shall be used in overhead slab construction wherever possible for the support of pull and junction boxes.
 - G. Feeders passing through pull or junction boxes shall be individually grouped and bound with tie-raps. The feeders in each pull or junction box shall be properly tagged to clearly indicate their electrical characteristics, circuit number and panel designation. Cables shall be supported on suitable racks within the boxes and arranged in an orderly manner.
 - H. Flush mounted ceiling and wall outlet boxes shall be provided with the proper type of extension rings, tile and plaster collars required to set flush with the finished surfaces of the ceiling or walls.
 - I. Ceiling fan rated outlet boxes shall be installed in all bedroom and livings and/or as indicated on the drawings. The fan boxes shall be nonmetallic, and "UL" listed for use with ceiling fans. Each box shall be equipped with adjustable mounting brace that spans the joists and each box shall be capable of accommodating up to 75 pounds of more.
 - J. Outlet boxes shall, in general, be as follows:
 - 1. Recessed outlet boxes in non-hazardous locations shall be fire rated, non-metallic, fiberglass impact resistant outlet boxes. The boxes shall be constructed to withstand extreme temperatures. Boxes shall not melt or distort due to high heat or shatter in extreme cold. All the non-metallic boxes shall be rated for use within Fire Walls or Fire Rated Ceilings. Boxes shall be secured to wood studs with nails, to sheet metal studs with pierce point sheet metal screws or a universal "Z" hanger that allows the box to mount to wood or metal studs.

2. Recessed outlet boxes for non-hazardous locations in areas where type "MC" cable is required (i.e.; common areas, garage, etc.) shall be the pressed sheet steel, zinc coated, cadmium plated type.
 3. Exposed, surface and pendant mounted outlet boxes or outlet boxes installed in normally wet locations shall be of the cast metal type with threaded hubs as manufactured by Hubbell, Crouse-Hinds, Red Dot, or Russell and Stoll.
 4. Outlet boxes shall not be less than 1-1/2 inches deep unless shallower boxes are required by structural conditions and are specifically approved by the Architect.
 5. Ceiling and bracket outlet boxes shall not be less than 4 inch octagonal, except that smaller box may be used where required by the fixture to be installed. Flush or recessed fixture shall be provided with separate outlet boxes where required by the fixture terminal temperature requirements.
 6. Outlet boxes on the exterior of the building shall be provided with UL Listed weatherproof covers that allow a plug to be in place with the cover in closed position. Covers shall be single gang, horizontal duplex, "in-use" application in accordance with Article 406 of the National Electric Code and as manufactured by Hubbell.
 7. Outlet boxes for general use, flush mounted in concrete work and walls in non-hazardous and normally dry locations, shall be manufactured by Hubbell, Steel City, or Raco.
 8. All outlet boxes shall be sealed with an approved sealant or insulator pads on all sides so that air flow does not leak into the finished space from the wall or ceiling cavity. All finished outlet plates shall be caulked with Phenoseal or other approved caulking on all edges of each plate. Phenoseal color shall match the color of the faceplate.
 9. Insulator pads shall be UL Listed cross link, close cell polyethylene insulating foam sized to fit the respective faceplate. Each foam pad shall be at least 1/8" thick and shall be used on all single gang and multi-gang devices including but not limited to outlet boxes, receptacles, CATV devices, telephone outlets, data outlets, etc. and shall be fire resistant made in the USA.
 10. Single gang or multi-gang non-metallic, vapor tight boxes shall be used on all exterior walls and within any vapor barrier. These boxes shall have a dry wall flange that is covered with closed cell-foam gasket and additional gaskets over cable entry points to provide a vapor tight seal. These outlet boxes shall be fire rated and UL listed.
- K. Pull and junction boxes shall, in general, be as follows:
1. Pull and junction boxes shall be constructed of code gauge galvanized sheet metal, of not less than minimum size required by the N.E.C. or other applicable Specification "STANDARDS" and shall be furnished with securely fastened covers. Boxes exceeding 48 inches in any direction shall be properly reinforced with angle iron stiffeners.
 2. Pull and junction boxes of other than standard manufacturer's trade size shall be manufactured by Steel City or Keystone.

3. Standard trade size pull and junction boxes shall be produced by the manufacturers listed above as applicable.
 4. Pull and junction boxes to be installed in normally wet location areas shall be of the cast type with threaded hub and gasketed cover plate. The cast pull and junction boxes shall be manufactured by Crouse-Hinds, or Appleton.
- L. Outlet, pull, and junction boxes shall be properly sealed during construction to prevent the entrance of dirt and foreign materials within same or the raceway system of which it is a part. The Electrical Contractor shall provide temporary covers for all open boxes. Paper may be solidly packed into standard work boxes to prevent the entrance of dirt and foreign materials, in lieu of cover plates if so elected by the Electrical Contractor.

2.07 AIR VAPOR BARRIER BOX

- A. Electrical contractor shall provide air-vapor barrier boxes at outlet boxes installed within any vapor barrier to provide airtight construction around all the outlets.
- B. The air-vapor barrier boxes shall be made of rigid polyethylene with a hinge feature to allow easy installation of any standard electrical outlet box.
- C. The air-vapor barrier boxes shall be installed by the electrical contractor and sealed by the air sealing contractor.
- D. The air-vapor barrier boxes shall be designed and installed to protect the seal made around the wires that enter or leave the box.
- E. The air-vapor barrier box shall allow for inspection and verification of a complete seal with air vapor barrier material before the wall is closed. This shall be coordinated in the field with the air sealing contractor.
- F. Single gang or multi-gang non-metallic, vapor tight boxes shall be used on all exterior walls and within any vapor barrier. These boxes shall have a dry wall flange that is covered with closed cell-foam gasket and additional gaskets over cable entry points to provide a vapor tight seal. These outlet boxes shall be fire rated and UL listed.

2.08 FIRE STOPPING

- A. Electrical contractor shall provide Intumescent fire stopping all around each conduit that penetrates a rated wall, floor and/or ceiling. Fire stop putty shall allow 10% movement and be water-based intumescent acrylate and have a shelf life of 12 months. The fire stopping shall be skin forming within 15 minutes and have an application temperature from 5 degrees C to 40 degrees C. Fire stopping shall be manufactured by Hilti.
- B. Fire stop putty pads shall be installed around outlet boxes that are located on party walls and/or fire rated walls or ceiling assemblies. Putty pads shall be intumescent, non-conductive, synthetic rubber and free from asbestos. The putty pads shall have an application temperature from 5 degrees C to 35 degrees C and a reaction temperature of 140 degrees C with a shelf life of 24

months. Putty pads shall be FM and UL 263 approved and manufactured by Hilti.

2.09 METAL CLAD CABLE

- A. All conductor wires and cables for secondary circuits shall consist of thoroughly tinned 98 percent conductivity copper, with 600 volt thermoplastic-covered (75 degrees C) insulation with an interlocked metal sheath, manufactured in strict accordance with the requirements of the Board of Underwriters' and the A.I.E.E..
- B. Wires, #10/2 w/GRD., #12/2 w/GRD., and #14/2 w/GRD., Metal Clad cable, type "MC", shall be type "THHN" solid, unless otherwise noted or shown on plans; sizes #6 AWG and larger shall be stranded Type "THHN".
- C. No wire smaller than 14/2 w/GRD. metal clad cable shall be used for any branch circuit. Larger sizes shall be used where so indicated on the plans.
- D. All wire shall be color-coded.
- E. All wire and cable shall be as manufactured by General Cable, Rome Cable, American Flexible Cable, or approved equal.
- F. Type MC cable shall not be used in concrete, direct buried in earth or where exposed to chemical vapors.
- G. Type MC cable can be used as panel feeders, branch circuits, run exposed, run concealed, in raceway, as open runs above ceilings, etc.
- H. Type MC cable shall be secured by insulated staples, cable-ties, straps and/or hangers at intervals not to exceed 6'-0' on center and within 12" of every cabinet, box or fitting.
- I. In addition to the line and neutral conductors, all Metal Clad cable shall be equipped with a full size, green insulated ground conductor that runs the entire length of every branch circuit.
- J. Metal Clad cable shall be used when circuits are run exposed and/or in all commercial areas within the building.

2.10 NON-METALLIC SHEATHED CABLE

- A. All conductor wires and cables for secondary circuits shall consist of thoroughly tinned 98 percent conductivity copper, with 600-volt thermoplastic covered (75 degrees C) insulation manufactured in strict accordance with the requirements of the Board of Underwriters' and A.I.E.E.
- B. Wires, #10-2 w/GRD., #10-3 w/GRD., #12-2 w/GRD. and #12-3 w/GRD. Non-metallic sheathed cable shall be type "TW" solid, unless otherwise noted or shown on the plans. Wire sizes #6 AWG and larger shall be stranded Type "THW". Wires underground or in slabs on grade shall be "THW" in concrete encased conduit, unless shown or noted otherwise.
- C. No wire smaller than 14-2 w/GRD., non-metallic sheathed cable shall be used for any branch circuit. Larger sizes shall be used where so indicated on the Plans.
- D. All wire shall be color coded.
- E. All wire and cable shall be as manufactured by General Cable, American Flexible Cable Company, Anaconda, or approved equal.

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- F. Type NM cable shall not be used in concrete, direct buried in earth or where exposed to chemical vapors.
- G. Type NM cable can be used for branch circuits, run exposed, run concealed, in raceway, as open runs above ceilings, etc.
- H. Type NM cable shall be secured by insulated staples, cable-ties, straps and/or hangers at intervals not to exceed 6'-0' on center and within 12" of every cabinet, box or fitting.
- I. In addition to the line and neutral conductors, all Non-Metallic Sheathed cable shall be equipped with a full size, green insulated ground conductor that runs the entire length of every branch circuit.
- J. Type "SER" cable shall meet the above-mentioned criteria and may be used in dry or wet locations at temperature not to exceed 90°C and shall be rated 600 volts and be UL Listed. Conductors shall be annealed soft copper or aluminum alloy, Type XHHW-2 or Type THHN/THWN, with a grey weather resistant and sunlight resistant PVC jacket. The type "SER" cable assembly shall be two-phase conductors and a bare neutral conductor. Concentric neutral conductors are not acceptable.
- K. Type "SER" cables shall have identifying colored stripes on the insulation of each conductor.
- L. Where type "SER" and/or type "NM" cable is used in Type I construction the electrical contractor shall provide sleeves for the cables in accordance with Article 334 and Article 338 of the National Electric Code or the contractor has the option to change the cables to type "MC" cable under these circumstances.

2.11 WIRES AND CABLES

- A. Unless otherwise specified, all wires and cables shall be thoroughly tinned 98% conductivity copper, single conductor type "THHN" moisture and heat resistant polyvinylchloride thermoplastic for use at 600 volts A.C. and D.C., rated 60 degrees C. operating temperature. Wires and cables #6 AWG and larger shall be type "THHN", unless noted otherwise. The wires and cable shall have the Underwriters' Laboratories, Inc. label and be surface printed throughout the entire length at two-foot intervals with permanent identifying markings indicating manufacturer's name, size, type, and voltage. All wire and cable shall be furnished on reels or spools and in lengths required to minimize splicing.
- B. All building wire and cable shall have a lead content of less than 300 parts per million.
- C. Services entrance conductors, conductors buried below grade and/or conductors exposed to the elements shall be type "THWN" and meet the criteria mentioned above.
- D. Fixture wiring for use on 250 volts A.C. shall be type XFF, cross linked, polyfin insulated, #14 AWG, 300 volts.
- E. Feeders and Branch circuit wire in continuous raceways shall be type "THHN", heat resistant, nylon covered thermoplastic.
- F. Emergency feeders shall be type "MI" cable. These feeders shall be utilized in areas that are not sprinkled, and a one-hour barrier and/or fire rated assembly does not exist.
- G. Wires of #12, and #10 AWG shall be solid, #8 AWG and larger shall be stranded.

- H. Wires and cables #2 AWG and smaller shall be of continuous solid colors follows:
 - 1. SYSTEM VOLTAGES: 120/208 3 PH., 4 WIRE

Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Equip.Grd.	Green
 - 2. All wires larger than #2 AWG shall be color-tape coded at all terminations.
- I. Where required by the HVAC system manufacturer, this contractor shall provide interconnection wiring between the roof mounted air-cooled condensing unit and the respective air handling unit within the respective dwelling unit. The exact wiring configuration shall be coordinated with the manufacturer.

2.12 LIGHT SWITCHES (Federal Spec. Grade)

- A. All local wall switches shall be of the flush Quiet **rocker** style, single pole, double pole, three-way or four-way, as required and as manufactured by Hubbell. Residential grade wiring devices will not be acceptable.
- B. All switches shall be mounted no higher than 48” above finished floor to the center of the device.
- C. All switches shall be suitable for the control of tungsten filament lamps, fluorescent loads and shall carry the proper marking of the Underwriters’ Laboratories.
- D. In all dwelling unit bathrooms, the toggle switch that controls the vanity light shall be a lighted when “OFF” toggle switch. The lit toggle switch shall be Hubbell #DS120ILW.
- E. All occupancy sensors shall be Passive Infrared / Ultrasonic dual technology with settings that range from 4 second to 20 minutes. The devices shall be wall mounted or ceiling mounted as indicated on the drawings. Sensors shall be digital pulse to interface with the microprocessor in the lighting control panels. Sensors shall be capable of multi-sensor application to allow for zone control.
- F. Switches and Occupancy Sensors shall be equal to the following Hubbell devices:

- Single-pole Rocker Switch DS120WLV
- Three-way Rocker Switch DS315W
- Single Pole Switch CSB120W
- Three-way Switch CSB3120W
- CFL and LED Dimmer switch RDVCL153PW
- Fan Speed Controller RDVCL153PW
- Ceiling Mounted Dual Technology Occupancy Sensor ADT1000CL
- Wall Mounted Dual Technology Occupancy Sensor ADD2000W1
- Wall Mounted Two Circuit Dual Technology Occupancy Sensor w/Night Light WS1020NW

- G. Color of devices shall White unless otherwise selected by the architect.

2.13 RECEPTACLES (Federal Spec. Grade)

- A. All convenience outlets shall be of the single or duplex type, back or side wired, T-slot and polarized slot type. All receptacles shall be of the grounded type and be rated 20-amp as indicated. Receptacles shall be manufactured by Hubbell and shall be plug tail style. Residential grade wiring devices will not be acceptable.
- B. Receptacles must feature a solid brass strap with integral ground break-off ears, brass auto ground clip crimped to the strap, wrap around face locking strap and locking drive screws and wide body design.
- C. All receptacles must be finger safe with built-in brass terminals to accept plug tail connector with solid or stranded #12 AWG conductors, including the ground conductor. The connector shall have large brass contacts with an audible snapping latch to assure connection and allow release.
- D. All receptacles must be finger safe with no exposed terminals after installation and shall have circuit identification in the label on the face of each receptacle.
- E. Exposed molded parts of the receptacles must be constructed of high impact-resistant nylon or polycarbonate and must match the faceplates.
- F. In general, convenience outlet circuits shall be independent of light circuits and shall not be controlled by light circuit switches or light switches, unless specifically shown.
- G. All twenty-amp circuits indicated on the drawings shall be wired to twenty-amp devices. The use of a fifteen-amp rated receptacle on a twenty-amp circuit is not acceptable.
- H. Standard duplex receptacles specified shall be used for dual circuited receptacles by removal of break-off shunt.
- I. Exterior receptacles and/or receptacles in wet locations shall be provided with an "in-use" cover in accordance with Article 406 of the National Electrical Code. Covers shall be polycarbonate construction with a watershed channel, cord flap gasket, 1" profile and have the ability of being installed without removing a device through the use of keyed mounting holes. In-use covers shall be manufactured by Hubbell # WIUC10-SC.
- J. All receptacles installed throughout the building complex shall be as follows, or equal to:
1. Duplex convenience receptacles 20A, 125V., single phase, 3 wire U-slot, Tamper Resistant, grounded type shall be Hubbell #5362TRW.
 2. Duplex 20A, feed thru, 125V, 1-phase, 3-wire, U-slot, Tamper Resistant ground fault interrupting convenience receptacle shall be Hubbell #GFTWRST20WNL
 3. Dryer outlets, 30A, 250V, NEMA 14-30R, 3-pole 4-wire, grounded type receptacle as manufactured by Hubbell.
 4. Range outlets, 50A, 250V, NEMA 14-50R, 3-pole, 4-wire, grounded type receptacle as manufactured by Hubbell.
 5. Exact NEMA configuration of all special purpose outlets shall be coordinated in the field with the equipment manufacturer and/or the General Contractor.

6. Color of devices shall be White unless otherwise selected by the architect.

2.14 OCCUPANCY SENSORS

- A. The electrical contractor shall furnish and install a wall mounted or ceiling mounted, dual technology, passive infrared (PIR) and ultrasonic occupancy sensor as indicated on the drawings. Each occupancy sensor shall turn lights on when PIR and ultrasonic technologies detect occupancy.
- B. The PIR technology shall sense the difference between infrared energy from a human body in motion and the background space. The ultrasonic technology shall utilize the Doppler Principle and high frequency (40kHz) ultrasound to sense motion within each space.
- C. Once the lighting is "on" either technology will hold the lights "on". When no occupancy is detected for the length of the pre-determined time delay, the lights turn "off".
- D. Each occupancy sensor shall be able to be set so that only one of the technologies is needed to turn lights "on" or both technologies can hold the light "on".
- E. Each occupancy sensor shall be 24-volt DC/AC equipped with an isolated relay with Normally Open and Normally Closed contacts rated for 1 amp @ 24 volts DC/AC
- F. Each occupancy sensor shall have built-in time delays as follows; automatic, fixed (5, 10, 15, 20 or 30 minutes), walk through and test mode.
- G. Each occupancy sensor shall have Sensitivity adjustments as follows; Smart Set (automatic) or reduced sensitivity (for PIR sensitivity); ultrasonic sensitivity is variable with built-in trimpot.
- H. Each occupancy sensor shall be equipped with a 2-200 footcandle light level sensor and shall have a low voltage momentary switch input for manual operation.
- I. Wall mounted sensors (Cristal Control #CC-WSDD1277CN) shall be equipped with an override off pushbutton.
- J. Ceiling mounted sensors (Cristal Control #CC-CDS2000U for 2,000 square foot coverage and #CC-CDS1000U for 1,000 square foot coverage) shall be capable of multi-sensor application to allow for zone control. Each device shall be dual technology, 360°, PIR and ultrasonic sensors. Occupancy mode or Vacancy mode shall be field selectable.
- K. Each occupancy sensor shall work with a power pack (Cristal Control # CC-PP1277) and each power pack shall be UL and CUL listed and come with a five-year factory warranty.

2.15 UNIVERSAL VOLTAGE POWER PACKS

- A. Each power pack shall multi-voltage (120/230/277 volt) on the primary side and 24 volts DC, 100mA on the secondary side.
- B. Each power pack, when connected shall turn the connected load on and off based on the occupancy sensor input.
- C. The power pack shall be able to control lighting, air conditioners, fans, pumps motors, VAV systems and motorized dampers.
- D. Each power pack shall be UL 2034 plenum rated.

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- E. Power pack shall have an LED to indicate the status of the relay or if there is a low-voltage over current condition.
- F. Each power pack shall be mounted inside or outside a 4" junction box.
- G. Each power pack shall be UL and CUL listed and come with a five-year factory warranty and shall be RoHS compliant.
- H. Each power pack shall be manufactured by Cristal Control # CC-PP1277.

2.16 MISCELLANEOUS GENERAL-PURPOSE DEVICES

- A. All other special and general-purpose receptacles called for on the Drawings shall be of the same grade as indicated above, ivory phenolic compound finish and manufactured by Hubbell or equal.

2.17 DEVICE PLATES

- A. All plates used on switch and plug receptacles in finished spaces where wiring is concealed, shall be non-metallic type. Plates on exposed conduits to be sherardized. Color of the device plates shall match their corresponding wiring device.
- B. Gang plates shall be used where multiple switches and/or receptacles occur at one location.
- C. Plates shall be of the same manufacturer as the wiring devices.

2.18 LIGHTING CONTACTORS

- A. Lighting contactors shall be suitable for ballasted lamps and filament at 480 volts maximum.
- B. The lighting contactors shall be 12-poles and mechanically held and designed to handle the switching of tungsten or ballasted lamps as well as other non-motor loads.
- C. The contactors shall be designed to withstand the large initial inrush currents of tungsten and ballast lamp loads as well as non-motor (resistive) loads without contact welding.
- D. The contactors shall be rated 30 amperes per pole.
- E. The contactors shall have an interlock that removes the power from the pickup coil and shall require application of power to release the contactor to the OFF position.
- F. The contactors shall be capable of operating such that it will not switch to OFF during power failure to the control circuit
- G. The contactor shall be installed in a NEMA 1 enclosure
- H. Mechanically-held contactors shall be Eaton / Cutler-Hammer type C30CN for 30 ampere rating.
- I. 30 ampere rated contactor shall have finger safe terminals and normally open and normally closed poles shall be interchangeable where the installation of the pole on the contactor base determines if the pole is normally open or normally closed and not the pole itself. Contactor shall be field configurable from electrically held to mechanically-held.

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2.19 LIGHTING FIXTURES

- A. The Contractor shall furnish and install the lighting fixtures, complete for each light outlet in the type, quality, and size of fixture indicated on the Plans and in the Fixture Schedule. It shall be the responsibility of this Contractor to check the Plans with the Schedule for completeness. Substitutes will not be accepted.
- B. If a substitute lighting package is requested by the owner or the architect, then this contractor will be required to submit the originally specified lighting fixtures along with the substitute package. A complete photometric plan and a Comm. Check Compliance calculation worksheet will be required to be submitted as part of the substitute package for review by the engineer. The photometric plan shall provide footcandle values for each and every room and area of the building along with a complete analysis of the site. If any information is missing, then the entire package will be returned and marked rejected and the contractor will provide the specified lighting fixtures.
- C. This Contractor shall include all fixture wiring, hanging, uncrating, connecting and making ready for operation. All fixture wire for fixtures shall not be less than #16 gauge, but larger if capacity of fixture requires it, and finished with asbestos-covered wires where exposed to excessive heat.
- D. This Contractor shall include the cost of furnishing and installing all lamps for all fixtures under this Contract throughout. All lamps for all fixtures shall be furnished in types as indicated. All lamps shall be Phillips, General Electric or Sylvania, as called for under each fixture type.
- E. The Contractor shall check structural and architectural details of all locations where fixtures are to be installed so that he can properly provide for installation of the fixtures.
- F. The electrical contractor shall furnish and install an ***E.Z. Barrier*** at all the down light locations that penetrate the rated ceiling assembly. The barrier shall maintain the fire rating indicated by the architectural drawings and specifications. The barrier shall comply with UL 263, UBC 7-1, NFPA 251 and ASI A2.1. The barrier shall be certified with American Society for Testing Materials (ASTM) specifications ASTM E119-00a, "Standard Methods of Fire Tests of Building Construction and Materials".
- G. All down light fixtures shall be rated "Air Tight" and "IC" for use in contact with insulation.
- H. All LED lighting fixtures shall be "chip-on-board" technology and shall come complete with its respective driver. All LED fixtures shall be provided with manufacturer's certified photometric report per Illuminating Engineering Society of North America (IES-NA) (LM-79) from an approved Department of Energy (DOE) laboratory to validate the manufacturer's photometric performance.
- I. All LED luminaires shall come with lumen depreciation (life) data information for each LED light fixture, supported by the LED chip manufacturer's IES-NA LM-80 test data that directly correlates to the respective fixture's performance.
- J. As indicated on the drawings, LED light fixtures that are dimmed should be dimmed with a 120-volt magnetic dimmer switch unless otherwise noted.
- K. All LED fixtures shall have a Color Rendering Index (CRI) of at least 85.

2.20 A.C. PANELBOARDS

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- A. Panelboards and all components shall be designed, manufactured, and tested in accordance with the latest applicable standards of NEMA and UL as follows:
1. UL 67 – Panelboards
 2. UL 50 – Cabinets and boxes
 3. NEMA PB1
 4. Fed. Spec. W-P-115C
 5. Circuit breaker – Type I class I
- B. The convertible distribution and lighting circuit breaker panelboards shall be the dead-front type and shall be in accordance with the Underwriters’ Laboratories, Inc. “Standard for Panelboards”, and “Standard for Cabinets and Boxes” and shall be so labeled.
1. All cabinets shall be made of code gauge steel or better and if painted shall be undercoated with a rustproof bonderized surface or galvanized and treated with a non-acid agent prior to painting. Fronts, provided with doors, shall be cold-rolled sheet steel with gray finish. Directory frames shall be included on the backs of all doors. All locks shall be keyed alike. Fronts shall be furnished with approved adjustable trim clamps and means shall be provided for entrance to gutter space, lugs, etc.
 2. Circuit breakers shall be of the bolt-on type, stab types will not be permitted, indicating “ON-OFF” “TRIPPED” positions of the operating handle. When the breaker is tripped automatically, the handle shall assume a middle position between an overload on one pole shall automatically cause all poles to open. Two or more single pole breakers with one handle extension will not be permitted. The circuit breakers shall be quick-break on manual, as well as automatic operation and shall have inverse time characteristics secured using a bi-metallic tripping element supplemented by a magnetic trip. Circuit breaker arc quenching shall be equal to or better than the “De-Ion” arc extinguishing principle.
 3. Where indicated, circuit breakers shall be molded case circuit breakers provided with electronic trip units for selective coordination. Ratings shall be as indicated on the drawings.
 4. All branch circuit breakers shall be a minimum of 1” per pole. Mini style circuit breakers are not acceptable.
 5. All panelboard assemblies shall be factory assembled complete with circuit breakers as shown on the Contract Plans. Interiors shall be so designed and assembled that any individual breaker can be replaced without disturbing adjacent units or without removing main bus or branch circuit connectors. All bussing shall be copper. Main buses and back pans of distribution and power panelboards shall be of such design that branch circuits may be changed without additional machining, drilling, or tapping. Where aluminum contact surfaces are furnished on main and branch circuit connectors, the aluminum shall have a 1,000 amperes/square inch density and contact surfaces of not more than 200 amperes per square inch. Silver Plated contacts which meet the same values are acceptable. Lighting and power branch circuit panelboards shall be so designed that the branch circuit connections to the main bus provide sequence (fully distributed) phasing, and such connections shall be clearly and permanently identified on the face of the front of the panel interior.
- C. Power Distribution Panels shall be convertible circuit breaker distribution Panelboards as manufactured by Eaton.

- D. Frame size for each breaker shall be as shown on the Contract Plans. All bussing shall be aluminum. The bare, solid, aluminum neutral bus shall be electrically insulated from the panel and a separate, bare aluminum grounding bus shall be provided in each panel. Aluminum ground bus shall be the equivalent of the solid neutral bus. Buses shall be clearly identified.
- E. Lighting Panels shall be circuit breaker Panelboards as manufactured by Eaton. Frame rating for each breaker shall be as shown on the Contract Plans. All bussing shall be aluminum. The bare solid aluminum neutral bus shall be electrically insulated from the panel and a separate, bare aluminum grounding bus shall be provided in each panel. Aluminum grounding bus shall be the equivalent size of the solid, neutral bus. Buses shall be clearly identified.
- F. Trims for branch circuit panelboards shall be supplied with a hinged door over all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts. Doors shall have a semi flush cylinder lock and catch assembly. Doors over 48 inches in height shall have auxiliary fasteners.
- G. A directory card with a clear plastic cover shall be supplied and mounted on the inside of each door. All locks shall be keyed alike.

2.21 METERING EQUIPMENT

- A. Furnish and install the service entrance rated metering equipment as herein specified and shown on the associated electrical Drawings. The modular metering shall meet all the requirements set forth by Underwriters' Laboratories and shall be listed and labeled.
- B. House panel meters shall be equipped with a circuit breaker (rating as indicated on the drawings) and by-pass kit on the respective meters in accordance with Utility Company requirements.
- C. All metering equipment shall be provided with copper bussing and bolted connections to provide one continuous structure.

2.22 SAFETY SWITCHES AND FUSES

- A. Safety switches shall be of the fusible or non-fusible type as indicated on Drawings equipped with an external lever or handle for manual operation. Each unit shall be enclosed in a code-cage, sheet steel cabinet suitable for surface mounting as indicated on the drawings. Surface mounted units shall have hinged door and catches. Neutral conductors shall be solid throughout. Weatherproof switches shall be of the NEMA 3R type.
- B. Safety switches shall be heavy-duty type as manufactured by Cutler Hammer.
- C. Furnish and install a complete set of fuses for installation and deliver to the Owner one complete set of spare fuses for each installation. Fuses shall be as manufactured by Chase Shawmut, Bussman, or Littlefuse/Tracor.
- D. Electrical contractor shall furnish and install a safety switch for each Air Handler, VTAC, PTAC, Fan Coil Unit (FCU), Condensing Unit, etc... indicated on the drawings. These switches shall be located so that they are accessible for operation in accordance with the NEC.

2.23 GENERAL PANEL INFORMATION

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- A. All panels shall be properly balanced, the circuit numbers on the Plans being a numerical indication rather than any attempt to indicate proper balance.
- B. Care shall be taken in the use of a common neutral to make certain that no more than one leg is taken from each phase.
- C. Typed indexes shall be provided in each panel indicating circuit number and the outlets or items controlled or fed from same.

2.24 MOTOR WIRING

- A. The Contractor shall do all wiring required for plumbing, ventilating and heating motors including mounting of switches and starters, as well as wiring of same. All wiring for the control of motors unless indicated on Electrical Plan, shall be provided under HVAC, Plumbing and Fire Protection.
- B. The Contractor shall furnish and install horsepower rated disconnecting means as required by the National Electrical Code for all motors. Motor-driven equipment specified under "Plumbing" and "Heating and Ventilating" may be factory wired complete with controller and motor disconnects; the Contractor shall coordinate equipment purchased under these divisions so as to provide any necessary equipment. Motor disconnects shall be unfused unless noted otherwise. Single-phase motor disconnects may be a thermal switch.
- C. Each disconnect shall be clearly labeled with a screw fastened ¼" engraved nameplate stating load controlled.

2.25 MOTOR STARTERS AND CONTROLS

- A. Motors will be furnished and installed under the respective Sections of the Specifications under which the equipment is specified.
- B. Motors ½ hp and larger will be 3 phase, 60 Hertz; motors less than ½ hp will be 120 volts, single, 60 Hertz, except specifically noted equipment.
- C. All motor starters and controls unless furnished as an integral part of the equipment, shall be provided with suitable metal enclosures and shall conform with the NEMA Industrial Control Standards.
- D. All motor starters shall have individual running overcurrent protection in each phase and shall be provided with two sets of auxiliary contacts. Starters for single-phase motors shall be 2 pole and for 3 phase motors shall be 3 pole.
- E. Manual starters shall be of the toggle mechanism type for full voltage starting. Magnetic starters shall be across-the-line type, minimum size NEMA 1 equipped with Hand-Off-Automatic switch.
- H. Each motor starter and each control station shall be clearly labeled with screw fastened ¼" engraved nameplate stating equipment controlled.

2.26 SECONDARY ELECTRICAL SERVICE

- A. Secondary electrical service shall commence at a secondary connection of the pad mounted transformer. Secondary connections shall be the responsibility of this contractor and the primary connections shall be the responsibility of the utility company.

- B. Electrical Contractor shall furnish and install conduit, wire, compression connectors from the secondary spades at transformer to main circuit breaker in the main switchboard. Sizes of which shall be indicated on the Drawings.
- C. Electrical Contractor shall furnish and install a concrete envelope around the secondary conduits as indicated on the drawings. The duct bank assembly shall be buried a minimum of 36 inches below the finished grade and each duct bank section shall have a yellow warning tape run the entire length of each duct bank. Backfill in trenches shall be select with no stone or rock larger than a ½" in diameter.

2.27 NAMEPLATES

- A. Nameplates shall be furnished and installed on all panelboards, pull boxes, cabinets, for all special purpose switches, motor disconnect switches, remote control stations, motor starters and other controls furnished under this Contract, to designate the equipment controlled and function. Nameplates shall be laminated black bakelite with ¼ inch high white recessed letters. Nameplates shall be securely attached to the equipment with galvanized screws or rivets.

2.28 SUPPLEMENTARY STEEL, CHANNEL, AND SUPPORTS

- A. The Electrical Contractor shall furnish and install all supplementary steel, channels, and supports required for the proper installation, mounting and support of all lighting fixtures and electrical equipment, to be installed under this Contract, as required.
- B. All supplementary steel, channels, and supports shall be furnished, installed, and secured with all fittings, support rods, and appurtenances required for a complete support mounting system.
- C. The type and size of the supporting channels and supplementary steel shall be determined by the Electrical Contractor and shall be of sufficient strength and size to allow only a minimum deflection in conformance with requirement for loading.
- D. All supplementary steel and channels shall be installed in the neat and workmanship manner parallel to the walls, floor, and ceiling construction. All turns shall be made with 90° and 45° fittings, as required to suit the construction and installation conditions.

2.29 TELEPHONE UNDERGROUND CONDUIT SYSTEM

- A. Electrical contractor shall be responsible for coordinating the exact location of cable television and telephone company points of connections. Once these locations have been established, the contractor shall install conduits to each location in accordance with the respective service provider's requirements.
- B. Hard line coaxial cable and telephone trunk lines shall be run to each floor of the building and be the responsibility of the respective service provider and coordinated with the electrical contractor.
- C. Furnish and install all conduits as indicated on the Drawings. Excavation and backfilling shall be furnished under another section of this Specification. This

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contractor shall be responsible for coordinating the exact connection point with the local telephone and cable service providers.

- D. All conduits in trenches shall be sloped for drainage away from any building or structure with a continuous pitch of 3" in 100' unless otherwise noted.
- E. All conduits shall be encased in concrete.
- F. All conduits shall be Schedule 40 PVC conduit as manufactured by Carlon, in 10' lengths, including all couplings and appurtenances necessary for laying in complete conduit line.

2.30 VOICE/DATA SYSTEM

- A. Backboards for voice/data equipment shall be furnished and installed by this contractor. Main backboard shall be as dimensioned on the Plans. All backboards shall be fire rated plywood painted white on both sides with fire resistant paint.
- B. The electrical contractor shall be responsible for all cross connections between the telephone and cable television service providers to ensure proper dial tone and High-Definition signal strengths are achieved.
- C. The electrical contractor shall be responsible for extending the voice/data services to the electric closets on the floors as indicated on the plans.
- D. The electrical contractor shall install a 3/4" micro-duct from each dwelling unit back to the respective backboard. Each micro-duct shall be equipped with a nylon pull wire with measurements indicated.
- E. All backboards shall be furnished with a ground bar with an insulated stand-off secured to the backboard. A #6 bare copper ground conductor shall be bolted to the ground bar with a two-hole high compression connector on one end of the cable and the other end of the cable shall be connected to a piece of bare building steel with an approved connector. The ground bar shall be capable of handling at least 12 subordinate connections.
- F. The electrical contractor shall furnish and install all equipment to the Main Backboard. The Electrical Contractor shall furnish all conduit and sleeves where required. The Electrical Contractor shall furnish and install all voice / data outlets and all wiring indicated below.
- G. The electrical contractor shall be responsible for cross connecting all incoming cables with the customer cables via terminal block and/or patch panels.
- H. Voice/data system wiring and devices in Common Areas shall be as follows:
 - 1. Voice wiring shall originate at the outlets indicated on the drawings and run to IDF closets as indicated on the plans or run back to the MDF closet. Wiring for voice outlets shall consist of 8/C #24 awg Category 6 solid annealed copper, individual insulated with high density PVC, and tough PVC outer jacket, plenum rated cables to each outlet. Cables shall be terminated to a RJ-45 jacks at the outlet locations indicated on the drawings. Voice cables should be White in color.
 - 2. Data wiring shall originate at the outlets indicated on the drawings and run to IDF closet as indicated on the plans or run back to the MDF closet. Wiring for data outlets shall consist of 8/C #24 awg Category 6 solid annealed copper, individual insulated with high density PVC, and tough PVC outer jacket, plenum rated cables to each outlet. Cables shall be terminated to a RJ-45 jacks at the outlet locations indicated on the drawings. Data cables shall be Blue in color.

3. Where indicated on the drawings, the electrical contractor shall furnish and install single and/or dual port jacks.
 4. Cables shall be UL CM rated, meet U.L. 444 and NEC article 800 requirements.
 5. The electrical contractor shall furnish separate and distinct 48-port patch panels for the voice and data cables as indicated on the drawings. Exact quantity of patch panels shall be determined by the contractor.
- I. The electrical contractor shall furnish and install an 8/C #24 awg Category 6 solid annealed copper, individual insulated with high density PVC, and tough PVC outer jacket, plenum rated cable to each Dwelling Unit network interface as indicated on the drawings.
 - J. Each network interface shall be installed in the entry closet in each unit and consist of an 8-way video splitter, 120-volt, 20-amp power receptacle, 4 x 10 punch down block, 4 x 8 RJ45 patch panel, 4 port router with 10/100 ethernet switch, mounting brackets, enclosure and hinged cover as manufactured by Hubbell #NSOBNK14.
 - K. Each Dwelling Unit Voice/data system wiring and devices shall be as follows:
 1. Each dwelling unit will be equipped with new RJ-45 telephone outlets in each bedroom, each living room and in each kitchen.
 2. Wiring from each outlet shall be run back to the network interface panel within in the respective dwelling unit and terminated on the patch panels using 8/C #24, plenum rated, Category 6 cable.
 3. New telephone outlets shall be flush mounted, single port RJ-45 outlets with matching faceplate.
 4. All cables and their installation methods shall comply with Article 770 and Article 800 of the National Electric Code.

2.31 ADDRESSABLE/ANALOG FIRE ALARM SYSTEM

- A. General Requirements:
 1. Comply with Division1, General Requirements and documents referred to therein.
 2. Provide all labor, equipment, and materials to complete the Life Safety Fire Alarm System work in accordance with local and State Regulations.
 3. Fire alarm system and components shall be listed to U.L. standard 864, 10th Edition and Manufactured by Notifier Company.
- B. Description of System:
 1. The Life Safety Fire Alarm System shall be an addressable, non-coded, electronically supervised, microprocessor-based system. It shall be complete with all necessary hardware, software and memory specifically tailored for this installation. It shall be possible to permanently modify the software on site by using an integral service console or with a personal computer and specific system software.
 2. A Notifier NFS2-3030 fire alarm control panel shall be installed in the main lobby. New addressable Signaling Line Circuits (SLC) will emanate from this panel to all the floors and new initiating devices as indicated on the drawings.
 3. This panel should be configurable from one to ten SLC's and support up to 3,180 intelligent addressable devices.

4. Provide smoke, carbon monoxide, fire detection, sprinkler supervision, and automated single stage evacuation control. Interface to environmental controls and auxiliary devices.
 5. Provide signal appliances and signal controls for the safe and orderly evacuation of the building.
 6. The Life Safety System shall generally consist of the following main components:
 - a. control panel with 24/10 batteries
 - b. addressable devices
 - c. supervisory relays for sprinkler devices, etc.
 - d. auxiliary devices for door holder, etc.
 - e. audio visual devices
 - f. LCD type annunciator
 - g. Framed graphic plan @ facp location
 - h. exterior beacon
 - i. exterior sprinkler bell
 - j. monitoring of the fire pump (if required)
 - k. emergency generator run light
 7. Locate the main components and all related devices as shown on the Plans.
- C. Automatic Alarm Operations:
1. Operation of an addressable alarm input device shall flash the alarm signal and annunciate on the alphanumeric LCD 80-character display. Display the type, condition, and a location message for the first alarm immediately without the need for operator response. Capture the display to annunciate an alarm. In the event the shared display is annunciating when events of a lower priority or the FACP is in the site-programming mode. Turn on a red alarm LED at the control panel.
 2. Sort new (subsequent) events by type and log into queues for display by emergency user selection. Sound a momentary audible signal for each event occurrence. Flash a queue LED when an unseen event exists in a queue. Update the display to annunciate the total by type and the chronological number of the event on display i.e. 3 alarm reports - #2 displayed.
 3. Activate the communicator to transmit the alarm signal to the fire department or a UL Approved central station.
 4. Sound the evacuation signals throughout the building.
 5. Should a fire official choose to operate the Signal Silence button to silence the audio portion of the system, the control panel shall turn on an alarm silenced LED while the signals are in the silence mode. Should a new alarm occur after signal silence, all the alarm devices shall re-sound.
 6. Air Handling Unit smoke detectors when activated shall shutdown the respective unit and all associated smoke and fire dampers. The exact location of all remote test stations shall be coordinated with the local fire department.
 7. Upon activation of elevator lobby smoke detectors, elevator machine room smoke detectors and/or elevator shaft smoke detectors the respective elevator shall home to the main level. Once the elevators have reached the main level the elevator doors shall open and remain open until the system has been reset. If the main level is in alarm, home the elevators to an alternate floor designated by the local fire department.

8. Upon activation of the sprinkler system flow switch associated with the elevator shaft an addressable control module shall send a signal to shunt trip the elevator feeder circuit breaker to de-activate power to the elevator controller.
 9. Upon activation of a system connected carbon monoxide detectors, a supervisory signal shall be sent to a UL Approved central station monitoring company via the digital communicator specified herein. This signal transmission shall be in accordance with NFPA 720, "Standard for Installation of Carbon Monoxide Warning Equipment in Dwelling Units 2005 Edition".
 10. De-energize all access control systems to allow doors to swing open freely via control modules at every location.
 11. De-energize door holders and access control components to release all fire doors.
 12. Elevator machine room and elevator hoist way smoke detectors when activated shall start the hoist way exhaust fan and open the hoist-way louver to ventilate the shaft.
 13. The contractor shall provide a time delay on the main flow switch to allow time for a subsequent flow switch to alarm first and annunciated at the FACP. This shall be coordinated with the local fire department.
 14. All smoke/fire dampers installed to protect smoke barriers or compartments shall be wired to a 120-volt emergency circuit and controlled through a programmable, addressable relay module. Upon activation of a general alarm signal, the relay shall open and cause the smoke/fire dampers to close. Once the system is reset, the damper shall go back to their previous position.
- D. Non-emergency User Operations:
1. Fire Alarm Control Panel (FACP) shall be equipped with full QWERTY keypad, Acknowledge/Signal, Silence/System, Reset/Drill switches, Automatic time control functions with holiday exceptions and Boolean logic equations.
 2. Log a trouble and turn on a System Trouble LED for all user features, which modify, bypass, or inhibit the normal operations of the fire alarm life safety system. Suppress the common trouble signal during delivery of alarm signaling.
 3. On the LCD, CPU, operation of the display ID code key shall annunciate the point identification address and description of the currently displayed device.
 4. Operation of the menu key shall call a smart prompt program to guide the user through LCD, CPU programming operations. Restrict the use of this program by password.
 5. Operation of the Reset/Drill Switch shall return the system to normal after all initiating devices have been returned to normal.
- E. Supervisory Operations:
1. Operation of an addressable supervisory input device shall flash the supervisory queue indicator, sound a momentary audible signal, and display on the alphanumeric shared display.
 2. Display the type, condition, and a location message for the first alarm immediately without the need for operator response if no fire alarms are present.

3. Log subsequent supervisory events in the supervisory queue for display by emergency user selection. Also, display the current total number of supervisory events and the chronological number of each event.
 4. Provide supervisory alarm priority to capture the display from a trouble or monitor event.
 5. Turn on a respective amber group individual zone LED at the control panel and activate the digital communicator.
- F. Quality Assurance:
1. Install in accordance with the NFPA and the National Electrical Code.
- G. Submittals:
1. Submit Shop Drawings for the control panel and all devices.
 2. Submit custom operational sequences for the emergency communications, peripheral devices, and fire alarm controls.
 3. Submit pictorials or photographs of control equipment overviews, modular components, and interconnecting cable charts.
 4. Submit a one-line diagram that indicates all devices and wiring methods that will be implemented.
 5. Provide system manuals, maintenance instructions and the name, address, and 24-hour telephone number of the service department of the SYSTEM SUPPLIER.
 6. The Electrical Contractor shall provide as-built floor plans showing all devices, control panel, and connections to mechanical equipment. Drawings shall show all conduit routing and sizes, all wire sizes, types, and numbers.
- H. Replacement of Defective Items:
1. Supply to the Architect a written agreement from the equipment manufacturer to supply new components to replace defective items without cost to the Contractor, where such defective items become evident during a period of one year from the approved certificate of completing.
- I. Control Panel:
1. Provide fire alarm control panel shall be in accordance with U.L. and N.F.P.A. requirements. Control panel shall be Notifier NFS2-3030.
 2. The system shall be housed in a surface wall mounted cabinet with a door and viewing windows as required. All annunciator indications, operating controls and instructions shall be clearly visible through the viewing window. The door shall be complete with a lock and two keys.
 3. All electrical connections shall be front accessible through the hinged inner door.
 4. The service console shall provide system activity LED's and event buffer display.
 5. The single person installation verification test shall allow silent and non-silent testing of all system components. In addition, it shall produce a detailed report listing relay and signal programming for each verified input.
 6. Provide the ability to field program on the panel or with the use of a personal computer equipped with system specific software. The software shall allow a qualified service technician to perform multiple level programming, detailed system diagnostics and print system summary reports. The FACP shall have an 80-column printer interface and two (2) USB ports.

7. Provide minimum of four (4) soft pushbuttons on the front of the FACP, each with the ability to disable the normal functions. The pushbutton shall be for the following functions;
 - a. Horn/strobes
 - b. Elevator recall functions
 - c. Door holder drop out
 - d. Duct smoke detectors
 8. The FACP shall have an 80-column printer interface and two (2) USB ports.
 9. Control panel shall be provided with a Radio Frequency shield to prevent interference and/or failure when firefighting personal key two-way radios when in close proximity to the FACP.
- J. Signaling Line Circuits
1. Provide the quantity of Signaling Line Circuits (SLC), style 4, 6 or 7 as indicated on the drawings. The Notifier NFS2-3030 shall support up to 3,180 intelligent devices (any combination of; ionization, photoelectric, thermal, or multi-criteria devices, pull stations, normally open contact devices, two-wire smoke detectors or relays). FACP shall have a minimum of two and up to ten SLC loops.
 2. Connect SLC's to a Loop Controller. Use RED, solid, twisted pair, type FPLP wire. Connect SLC's, Class A style. Class B wiring shall not be acceptable.
 3. Each SLC shall have a ground fault LED in the FACP to monitor the circuits for ground faults.
 4. Each addressable device shall have a unique address. The manufacturer shall program each address and correlate them to output operations per the Plans and this Specification. Non-functioning, non-addressed and non-programmed devices shall report trouble. FACP shall provide for site modification to the addressable programming. The system shall provide for removal of devices without the necessity of re-addressing any other devices. Provide installation flexibility to the contractor by ensuring that the physical sequence (placement) of the devices on the loop need not determine the device address.
 5. Address and connect, addressable alarm receiving devices to the addressable loop as recommended by the manufacturer. Devices on each SLC shall be polled in less than two seconds and activate in less than five seconds. The manufacturer shall provide installation tables to identify all device addresses.
 6. Connect each normally open sprinkler supervisory device to a dedicated addressable transponder. Annunciate each supervisory addressable input device alarm or trouble operations on the LCD. Provide an individual status description on the LCD for each supervisory device.
 7. Connect each normally open Carbon Monoxide detector to a dedicated addressable transponder. Annunciate each supervisory addressable input device alarm or trouble operations on the LCD. Provide an individual status description on the LCD for each supervisory device.
 8. Provide circuits to monitor auxiliary devices such as smoke dampers and fan operation as shown on the Plans. Annunciate open or shorts as required. Provide an individual status description on the LCD for each circuit and display a message on the LCD.
- K. Notification Appliance Circuits (NAC):

1. All NAC's shall be power limited, supervised circuits, field programmable for any of the following operations:
 - Audible or Visual signals controlled by signal silence.
 - Audible or Visual signals controlled by system reset.
 - Remote auxiliary devices, which DO or DO NOT operate in the degraded mode. This shall be determined upon field requirements and be selectable during programming.
 2. The FACP shall be equipped with a six (6) amp switch mode power supply with four Class A or B, built-in NAC circuits. All audio/visual devices shall be synchronized and field selectable as specified herein.
 3. The system manufacturer shall provide, as necessary, auxiliary power supplies. The auxiliary power supplies shall provide power limited, supervised circuits for audio/visual devices. All auxiliary power supplies shall have built-in batteries and a charging circuit. Auxiliary power supplies shall be powered from a 120-volt dedicated power source. Exact quantity of auxiliary power supplies shall be coordinated with system manufacturer.
- L. Auxiliary Relays:
1. Auxiliary relay module shall be provided with four, type "1C" site programmable relays.
 2. Provide auxiliary relays with switches and status descriptions on the LCD for control functions as listed in the operations and as shown on the Plans. Relays shall be dust tight with fuse protected contacts rated at 24 VDC/120 VAC, 2.5amps. Inductive at a .35 power factor. Each relay will have a follower LED which verifies operation of the relay.
- M. Central Station Connection:
1. Provide a dual path, 5G Cellular/IP UL864 compliant, commercial communicator connected to the FACP. The dual path communicator shall connect directly to the primary and secondary communication ports of the FACP. The communicator shall report to the FACP; AC power loss and low battery condition. The communicator shall be installed in a RED cabinet with a Cam Lock and Key, 50-ohm cable and antenna assembly, power boost, 24-hour battery backup through the use of 7 Amp Hour Battery and battery harness, wall outlet connection (#K14358), LED display, mounting rails, and 18 volt transformer. The communicator shall be Honeywell #IPGSM-5G and shall transmit Contact ID reports to the central station either over the Internet or GSM network.
- N. Fire Alarm Common Controls and CPU:
1. Common control/CPU shall be self-configurable and able to map to the display module by I/O module type. It shall have built-in field programmable software capable of being programmed and configured on site using either the built-in service console or a personal computer with system specific software. The computer shall be capable of connecting to the USB ports.
 2. Provide a LCD CPU/Common Control Central Processing Unit with a 2 line 80-character LCD display and switches for common control, programming functions and alarm displays.
 3. Universal Display modules shall connect to the CPU and provide all point identification and/or control functions.

4. Provide the following indicators: Power ON LED, Signals Silenced LED, Point Disabled LED, System Trouble LED, Supervisory LED, Security LED, Pre-Alarm LED, Fire Alarm LED, NAC #1 LED's, NAC #2 LED's, NAC #3 LED's, NAC#4 LED's, SLC #1 Ground Fault LED, SLC #2 Ground Fault LED and Earth Fault LED.
 5. Provide the following keypad switch controls; Ground fault detection Enable/Disable, Disable/Enable switch for back-up alarms for (4) NAC's, Acknowledge/Scroll Display switch, Signal Silence switch, Drill switch, Reset switch and Lamp Test switch.
 6. The Liquid Crystal Display (LCD) shall be of the super twist high contrast characters. Provide non-interleaving event display by type sorting input events into queues. Types shall be fire alarm, supervisory alarm, trouble, and monitor. Provide a full alpha numeric 80-character (2 x40) display to support site programming. Initiate a trouble signal if programming input is incomplete.
- O. System Supervision:
1. Hardware or software fault detection shall activate the audible and visual trouble indicators. Operation of the silence push shall silence the audible signal, but the LED shall remain on. A new fault shall resound the signal. It shall not be possible to turn off the trouble LED until the system is clear of all faults. The common trouble circuit operation shall be independent of the CPU.
- P. Trouble Reporting:
1. All by-pass conditions such as auxiliary or fire department by-pass.
 2. All wiring to all fire alarm devices.
 3. Power connections and data transmissions.
 4. All control panel hardware for placement.
 5. All software routines and all program data for change.
 6. All volatile memory for failure.
 7. Primary and secondary power.
 8. All field wiring for ground faults.
 9. Maintain a record in memory of fault events.
 10. Identify faults by code to simplify service trouble shooting. Standard system reset shall not erase this record.
- Q. System Power:
1. Provide primary operating power of 120 Volts A.C. 60 Hz. Use modular no brake system power supplies with integral battery chargers capable of recharging within 12 hours.
 2. Provide supervised secondary battery power to operate the entire system for 60 hours under normal conditions. At the end of 60 hours, the standby source shall power the system under alarm conditions for 10 minutes.
- R. System Protection:
1. Provide high voltage transient protection all circuits. Minimum protection shall be 1000V for alarm receiving, 1500V for signaling, and 2500V for power supplies.
 2. Protect sensitive electronics subject to static damage. Installer access to areas with static sensitive parts shall not be necessary.

3. Protect controls and annunciation behind locked doors all keyed alike. Provide door windows to allow viewing of all common controls and system annunciation.
- S. Addressable Devices:
1. Provide input devices such as manual stations, smoke detectors, duct smoke detectors carbon monoxide detectors and heat detectors with built-in addressable transponders. Set a unique address at each device.
 2. For heat detectors with fixed temperature ratings higher than 135 F, provide separately mounted transponders outside of, or away from the high heat areas.
 3. Provide separately mounted transponders for other input devices such as:
 - sprinkler flow
 - sprinkler supervisory
 - low pressure switches
- T. Flow and Tamper Switches:
Flow and Tamper Switches shall be furnished and installed under the Fire Protection division, wire by the Electrical Contractor. Provide Monitor module for each of these devices for addressability to FACP.
Tamper switches shall be wired such that upon activation, a supervisory signal is sent by the control panel to a U.L. approved central station monitoring company via communicator.
- U. Addressable Pull Stations:
1. Manual Fire Alarm Stations shall be non-coded, dual action type pull station. The pull stations shall be capable of being opened without causing an alarm condition. An operated device is when the handle latches in the down position and the word "ACTIVATED" appears. This is the indication that the station has been operated. Each station shall be equipped with a built-in bicolor LED, which shall be visible through the handle of the station. The LED shall flash during normal operation and shall latch steady, RED when in alarm. Manual stations shall be constructed of molded durable Lexan with a textured finish. Stations shall be suitable for surface mounting on matching back box, or semi-flush mounting a standard single gang box and shall be installed not less than four and one-half feet above the finished floor. Manual stations shall be Underwriters Laboratories Listed. Provide an addressable monitor Modules with each station. Manual station shall comply with ADAAG guidelines for controls and operating mechanisms (Section 4.1.3, 13) and meet ADA requirements for 5 pounds maximum activation force. Each device shall be equipped with a Category 30 key operated reset.
- V. Addressable Photoelectric Smoke Detectors:
1. The Contractor shall install, where indicated on the Plans, plug-in, two-wire intelligent Analog / Addressable Photoelectric type smoke detectors and matching bases. The detectors shall be the self-verification type and have integral analog communications, built-in type identifications, and two blinking LEDs. The LEDs shall blink each time the device is addressed and shall be continuously illuminated when the detector is in alarm. The addressing switches shall be in the detector bases which shall be directly connected to an SLC for two-way communication with the FACP. The bases shall accommodate

matching ionization and thermal detectors. The bases shall be capable of mounting to outlet or device boxes and have provisions for surface mounting. The detectors shall have a built-in test switch and shall be capable of remote testing from the FACP. Devices with addressable switches or settings in the heads shall not be accepted.

W. Addressable Heat Detectors:

1. The Contractor shall install, where indicated on the Plans, plug-in, two-wire intelligent Analog/Addressable fixed temperature heat detectors and matching bases. The detectors shall be continuously monitored to measure any change in their sensitivity due to temperature and have integral analog communications, built-in type identifications, and two blinking LEDs. The LEDs shall blink each time the device is addressed and shall be continuously illuminated when the detector is in alarm. The addressing switches shall be in the detector bases which shall be directly connected to an SLC for two-way communication with the FACP. The bases shall accommodate matching smoke detectors. The bases shall be capable of mounting to outlet or device boxes and have provisions for surface mounting. The detectors shall have a built-in test switch and shall be capable of remote testing from the FACP. Devices with addressable switches or settings in the heads shall not be accepted.

X. Addressable Multi-Criteria Detectors (Carbon Monoxide/Smoke Detectors):

1. The Contractor shall install, where indicated on the Plans, plug-in, two-wire intelligent multi-Criteria detectors and matching bases. The detectors shall be continuously monitored and fully listed to UL Standard 2075. Each detector shall be equipped with a trouble relay, which sends a sensor failure or end-of-life signal to the control panel and the central station via the digital communicator.
2. If a detector senses carbon monoxide it shall alert by sounding and flashing a temporal 4 signal pattern. Each detector shall be addressed and shall be provided with dual color LED (green for normal/standby and red for alarm) indication, which blinks 1 per minute, to indicate normal standby, alarm, or end-of-life. When the sensor supervision is in a trouble condition, the detector shall send a trouble signal to the FACP. When the detector gives a trouble or end-of-life signal, the detector should be replaced.
3. Each detector shall be provided with a mini monitor module shall fit in a standard single gang box located above the detector it is monitoring. The addressing dials shall be located as part of the mini monitor module which shall be directly connected to an SLC for two-way communication with the FACP. The detector base shall be capable of mounting to a standard single gang outlet or device boxes and have provisions for surface mounting. The detectors shall have a built-in test switch and shall be capable of remote testing from the FACP.
4. Each detector shall be in full compliance with UL 2075, be equipped with a trouble relay, electromechanical sensing technology and supervised wiring shall be accomplished with Phillips head SEMS screw terminal connections.
5. Duct mounted carbon monoxide detectors shall be equipped with a sampling tube installed within the duct work.
6. Carbon monoxide detectors shall be manufactured by Notifier (#N-MMCO).

Y. Signal Appliances:

1. Strobe Units
 - i. Use red wedge-shaped strobes clearly labeled "FIRE" in white letters. Polarize the strobes for supervised operation. Strobes shall provide a high intensity flashing light for visual signaling. Strobe units shall mount surface or flush as indicated on the plans and mount to a standard 4" x 2 1/8" back box with no extension ring required. Strobe Units shall be synchronized and comply with ADA and be UL approved. All strobe units shall be field selectable on the front of the unit with multi-Candela settings of 15/30/75/110 candela.
 - ii. All strobe units installed in Hearing Impaired dwelling units shall 177 candela.
2. Signal Horn/Strobes
 - i. Provide red units with white letters clearly labeled "FIRE". Each device shall produce a minimum of 75 Candela with a Xenon Strobe Light and an audible signal that will produce not less than 87 dba sound output. Horn/Strobe devices shall be synchronized and comply with ADA and be UL approved. Mount devices flush or surface as indicated on the plans and mount to a standard 4" x 2 1/8" back box with no extension ring. All horn/strobe units shall be field selectable on the front of the unit with Multi-Candela settings of 15/30/75/110 candela and have at least two (2) selectable horn tones and three (3) decibel settings.
3. Low Frequency Sounders in Sleeping Areas
 - i. Provide units with a minimum of 87 db utilizing a low frequency audible signal tone of 520 Hz (+/-10%) square wave output in accordance with UL 464 requirements at 24 volts DC. Mount flush or surface as indicated above or as indicated on the plans and mount to a standard 4" x 2 1/8" back box with no extension ring. All horn units shall have at least three (3) decibel settings.
- Z. Auxiliary Devices:
 1. Provide remote control relays connected to supervised auxiliary circuits for control of fans, dampers, door releases, etc. Relay contact rating shall be 5 amperes at 120-VAC resistive or 2.5 amperes at 120-VAC inductive for a .5 power factor.
 2. Provide flush wall mounted electromagnetic door holders. Holders shall mount to a standard single gang outlet box. Holders shall be rated 24V DC and shall release upon activation of the fire alarm system.
 3. Beacon, provide a 24 VDC exterior Weatherproof Beacon constructed with a Lexan lens a heavy-duty xenon strobe lamp. Beacon shall be similar to Amsec #SL-5 or equal.
 4. Electrical contractor shall be responsible for wiring the exterior sprinkler strobe light and/or electric bell with 2/C #14 Type "MC" cable from the main flow switch within the sprinkler system.
- AA. Installation:
 1. Install a new Notifier NFS2-3030 Fire Alarm Control Panel in the lobby or as indicated on the drawings. Power to the new FACP shall originate from a dedicated 120-volt emergency power circuit.

2. Install new auxiliary power supplies complete with battery back-up as indicated on the drawings. Power to the new power supplies shall originate from dedicated emergency power 120-volt circuits.
3. Install horn/strobe devices in all corridors and common areas as indicated on the drawings. These devices shall be surface or flush mounted at the heights indicated on the drawings. These devices shall be connected to a NAC circuit with 2/C #14 type FPLP wire.
4. Install new automatic alarm initiating devices (ie, manual pull stations, smoke detectors, heat detector, flow switches, duct smoke detectors, etc.) as indicated and connect to an SLC. Mounting heights and locations shall be as indicated on the drawings and coordinated with BFD.
5. Install duct detectors and Remote Test Stations in HVAC equipment as indicated on the drawings. Mount duct smoke detectors at a suitable location in the return air duct work of units 2000 cfm or greater. In units that are rated 15,000 cfm or greater, duct smoke detectors and remote test stations shall be installed in both the supply and return air streams of the unit. Mount duct detectors in a readily accessible location for maintenance.
6. Install audible signal devices as indicated and connect to NAC's. NAC wiring shall be suitable for Class II. The NAC panels shall be installed in the locations indicated on the drawings and be equipped with stand-by batteries and a control module to trip the audio/visual devices connected to it. A dedicated 120-volt power feed shall be brought to each of these panels. The respective circuit breakers shall be locked in the "on" position and the NAC panel shall be labeled with its source identified on the inside cover.
7. Connect all door holders to the fire alarm system such that the designated doors release upon activation of the fire alarm system.
8. Connect all access control door controllers to the fire alarm system with a programmable control module. The control module shall be programmed to interrupt the power to the access control door equipment to allow the respective door to swing freely. The installing contractor shall maintain a positive latching mechanism to any exit stair doors that needs to maintain a positive latch for the integrity of the fire resistance enclosure.
9. All fire alarm wiring including riser cables shall be plenum rated type FPLP/FPLR cable.
10. The contractor shall be responsible for the supply and installation of the cable, wire, wire pulling, junction boxes, electrical boxes, and terminal cabinets in accordance with the manufacturer's recommendations but shall be no smaller than what is indicated on the drawings. The manufacturer shall allow for the necessary amount of onsite assistance for the contractor during the construction period.
11. The electrical contractor shall furnish and install a framed graphic map showing all the initiating points on the system. The graphic plan shall be located next the FACP.

BB. Verification and Certification:

The manufacturer shall inspect the Life Safety equipment. The inspection shall include all equipment necessary for the direct operation of the system such as input and output devices. Verify wiring connections to ensure that all equipment meets applicable codes and standards. Verify equipment supplied by the

manufacturer has been installed per the manufacturer's recommendations. Verify the operation of all devices. Verify the wiring to all supervised devices is supervised.

2.32 POWER LIMITED FIRE ALARM CABLE

- A. Power-limited fire alarm cable shall be used in power-limited circuits in accordance with Article 760 of ANSI/NFPA 70, "National Electrical Code" (NEC).
- B. Unless a higher temperature rating is marked on the cable, power-limited fire alarm cable is intended for use where operating temperature does not exceed 60°C. The voltage rating shall be 300 Volts.
- C. Power-limited fire alarm cable shall be identified by a marking on the surface of the jacket or on a marker tape under the jacket. This marking shall include one of the following Type designations:
 - i. **FPLP** — Indicates cable intended for use within buildings in ducts or plenums or other spaces used for environmental air in accordance with Section 760.154(A) of the NEC. This cable shall exhibit a maximum peak optical density of 0.5, a maximum average optical density of 0.15, and a maximum flame spread distance of 5 ft when tested per ANSI/NFPA 262, "Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces."
 - ii. **FPLR** — Indicates cable intended for use within buildings in vertical shafts in accordance with Section 760.154(B) of the NEC. The flame propagation height of this cable shall be less than 12 ft when tested per ANSI/UL 1666 "Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts."
 - iii. **Power Limited Fire Alarm Cable** — Indicates cable suitable for use within buildings (1) where the cable is enclosed in a raceway, or (2) in non-concealed spaces where the exposed length of cable does not exceed 10 ft, in accordance with Sections 760.154(C)(2) and (3) of the NEC. This cable shall comply with the VW-1 Flame Test requirements in ANSI/UL 1581.
- D. Cable marked "sunlight resistant" or "sun res" may be exposed to the direct rays of the sun.
- E. Cable marked "**CI (max voltage 300)**" is suitable for use as circuit integrity cable at the maximum voltage to ground indicated, in accordance with Section 760.179(G) of the NEC.
- F. Cable marked "wet" or "wet location" is suitable for use in wet locations.
- G. All conductor wires and cables for fire alarm circuits shall consist of thoroughly tinned 98 percent conductivity copper.
- H. Wires shall be a minimum of, #14/2 Shielded for the audio circuits, #14/2 for the Strobe circuits and #14 Twisted Pair for initiating circuits. All cables shall be solid conductors, unless otherwise noted or shown on plans.
- I. All wire shall be color-coded.
- J. All wire and cable shall be as manufactured by General Cable, Rome Cable, Anaconda, or approved equal.

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- K. Fire alarm cables shall be secured by insulated staples, cable-ties, straps and/or hangers at intervals not to exceed 6'-0' on center and within 12" of every cabinet, box or fitting.

PART 3.00 – EXECUTION

3.01 GENERAL PROVISIONS

- A. All locations of equipment and materials are subject to review by the Architect to coordinate with field conditions.

3.02 TESTS

- A. The right is reserved to conduct acceptance tests of all equipment wiring or any other work furnished under these Drawings and/or Specifications to determine the fulfillment of specific requirements and/or design.
- B. The Electrical Contractor shall conduct all such tests in the presence of authorized representative of the Owner and at such times that the Owner may designate.
- C. The Contractor shall perform all tests, supply all instrumentation, personnel and make all adjustments of equipment and wiring as may be necessary. Insulation resistance readings of all equipment and circuits shall be taken by the Contractor in the presence of the Owner's representative. Megger readings of less resistance than the recommended minimum as called by Section 110-7 of the NEC shall be required or replaced by this Contractor at no cost to the Owner.

3.03 GROUNDING

- A. The Contractor shall furnish and install all material required for a grounding electrode system and a supplemental grounding electrode system and bonding in the building of all equipment and power system components as shown on the Drawings and/or specified, as a minimum.
- B. Acceptable grounding electrodes shall be the following; metal underground water pipes, Metal in-ground support structures, concrete encased electrodes, ground ring, rod and pipe electrodes or plate electrodes.
- C. Any ground rods called for on the drawings or specified herein shall be a minimum of $\frac{3}{4}$ " diameter x 10'-0" long copper rods. Rods shall be driven a minimum of 8'-0" into the earth.
- D. All grounding connectors shall be high compression connectors, exothermic welds, or bolted clamp connectors. All connectors shall be UL listed for the application and shall be listed for direct soil burial in earth or concrete encasement. Not more than one conductor shall be connected to any single clamp or fitting.
- E. The electrical contractor shall be responsible for grounding the reinforcing bars within the foundation and/or floor slabs that are in contact with the earth for a minimum of 20'-0" with a #4 AWG copper bonding jumper with exothermic welded connections or high compression connections.
- F. Any bonding jumper that penetrates the floor shall be sleeved with a non-metallic protective sleeve.

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- G. Each feeder and branch circuit shall have a Green insulated ground conductor installed the entire length of the respective circuit configuration.
- H. Grounding shall conform to NEC Article 250.

3.04 INSTALLATION OF WIRING AND CONDUIT

- A. In general, all wiring is to be run concealed unless otherwise indicated to be run exposed. Exposed wiring in the mechanical spaces is acceptable.
- B. Raceways shall be continuous from outlet to outlet and from outlets to cabinets, junction and pull boxes, and shall enter and be secured to all boxes in such manner that each system shall be electrically continuous from service to all outlets. Terminal of all conduits shall be furnished with double locknuts and bushings.
- C. Exposed conduits shall be run parallel to or at right angles to the wall of the buildings, and all bends shall be made with standard ells or bent to not less than the same radius. Horizontal runs of exposed conduits shall be close to ceilings, passing over water or other piping where possible and shall be supported by pipe straps or by other approved means, not more than five feet apart.
- D. In no place shall conduit be run within six inches of hot water pipes or appliances, except where crossing is unavoidable, and in that case the conduit shall be kept at least one inch from covering of pipe crossed.
- E. Conduits shall be supported on approved types of galvanized wall brackets, ceiling trapeze, strap hangers or pipe straps, secured by means of toggle bolts on hollow masonry, machine screws on metal surfaces or wood screws on wood construction. No nails shall be used as a means of fastening boxes or conduit.
- F. In general, no splices or joints will be permitted in feeder cables, and branches shall be spliced at outlets or accessible junction boxes.
- G. All splices in wire #6 AWG and smaller shall be standard pig-tail made mechanically tight, then cleaned, and insulated with proper layers and thickness or rubber and friction tape. Wire splicing nuts, Thomas and Betts, Sta-Kon or Minnesota Mining and Manufacturing Co., Scotchlock Type R, may be used subject to approval of the local inspector. Joints, tape and splices in wire #6 AWG and larger shall be taped with approved rubber and friction tapes providing insulation not less than that of the conductor over Burndy Servits or equivalent connectors made by Penn Union or Blackburn.
- H. Wire #6 AWG and larger shall be connected to panels and apparatus by means of approved lugs and connectors. Connectors shall be solderless type, sufficiently large to enclose all strands of the conductor and securely fastened.
- I. Non-Metallic Sheath cable shall be supported by staples, cable ties, straps or approved method so designed and installed as to not cause damage to the cable. Cables shall be secured at intervals not to exceed 4 ½" on center and within 12" of every cabinet box or fitting.
- J. Wiring method shall conform to local wiring inspector. Prior to submitting bid, Contractor shall confirm wiring method to be allowed by local ordinances.

3.05 INSTALLATION OF OUTLET BOXES

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- A. Outlet boxes shall be of size and type to accommodate structural conditions; size and number of raceways; conductors or cables entering; and device or fixture for which required.
- B. Install blank plates on all outlet boxes in which no apparatus is installed, which do not integrally provide a cover for box.
- C. Special care should be taken to set all boxes correctly, square and true with the building finish. The edge of the box shall come flush with the building finish. As far as possible, all wall and switch outlets shall be erected in advance of furring and fireproofing and shall be secured to the building structure or steel by adjustable strap iron supports, which shall be buried.
- D. The exact location of all outlets and switches in finished rooms shall be obtained from the Architect and from the scale drawings of interior details and finish. Final correct readjustment shall be made to outlets, if necessary, to give proper centering.
- E. The locations given or designated on the Plans for the outlets are subject to notifications. In the case of local wall switches to be set at or near doors, the definite location shall be as established on the side of the door opposite the hinge.
- F. All outlet boxes shall be provided with Insulator pads that are UL Listed cross link, close cell polyethylene insulating foam sized to fit the respective faceplate. Each foam pad shall be at least 1/8" thick and shall be used on all single gang and multi-gang devices including but not limited to outlet boxes, receptacles, CATV devices, telephone outlets, data outlets, etc. and shall be fire resistant made in the USA.
- G. Any outlet box that penetrates the architectural vapor barrier membrane shall be provided with an air-vapor barrier box to provide airtight construction around all the outlets.

3.06 OUTLET BOX MOCK UP

- A. Electrical contractor shall be responsible for mocking up outlet locations for all the typical units indicated on the Typical Unit Plans. This shall include but not be limited to; receptacles, switches, lighting fixtures, data locations, fire alarm devices, etc... Any minor change or addition request by the owner or owner's representative shall be done at no expense to the project.
- B. Electrical contractor shall be responsible for mocking up outlet locations for all the common areas, amenity space, living rooms, dining rooms, etc. This shall include but not be limited to; receptacles, switches, data locations, fire alarm devices, etc... Any minor change or addition request by the owner or owner's representative shall be done at no expense to the project.

3.07 JUNCTION AND PULL BOXES

- A. Junction and pull boxes shall be furnished and installed under this Section of the Specification were indicated on the Drawings and wherever else such a box may be deemed necessary to facilitate the pulling or splicing of wire and cable.

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- B. All such boxes must be made accessible and shall be built only from the approved detail working Drawings. Conduits shall enter these boxes through tight-fitting clearance holes.
- C. The covers of the boxes shall be designed for quick removal. Where junction boxes are required for a splicing box for special recessed fixtures, consult the Architect before installing boxes for these fixtures and determine the exact location of the boxes.
- D. Each feeder passing through a pull box shall meet the approval of the Architect. Generally, junction boxes and pull boxes shall not be exposed in finished areas; where necessary, reroute conduits or make other arrangements to meet the approval of the Architect.
- E. Outlet, pull and junction boxes shall be properly sealed during construction to prevent the entrance of dirt and foreign materials within same or the raceway system of which it is part. The Electrical Contractor shall provide temporary covers for all open boxes. Paper may be solidly packed into standard work boxes to prevent the entrance of dirt and foreign materials, in lieu of cover plates if so elected by the Electrical Contractor.

3.08 LIGHT SWITCHES

- A. In general, convenience outlet circuits shall be independent of light circuits. In all cases the light switches shall be located opposite hinge side of door, per latest Architectural Drawings

3.09 GENERAL PANEL INFORMATION

- A. All panels shall be properly balanced, the circuit numbers on the Plans being a numerical indication rather than any attempt to indicate proper balance.
- B. Care shall be taken in the use of a common neutral to make certain that no more than one leg is taken from each phase.
- C. Typed directories shall be provided in each panel indicating circuit number and the outlets or items controlled or fed from same.

3.10 MOTOR WIRING

- A. The Contractor shall do all wiring required for plumbing, ventilating, and heating motors including mounting of switches and starters, as well as wiring of same. All wiring for the control of motors, unless indicated on Electrical Plans, shall be indicated in HVAC, Plumbing and Fire Protection Sections.
- B. The Contractor shall furnish and install starters and fused disconnecting means as required by the National Electrical Code for all motors. Motor-driven equipment specified under "Plumbing" and "Heating and Ventilating" may be factory wired complete with controller and motor disconnects; therefore, the Contractor should check equipment purchased under these divisions so as to avoid duplication of protective and disconnecting means. Motor disconnects shall be fused unless noted otherwise. Single phase disconnects may be thermal switches.

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- C. The Contractor shall furnish and install a fused disconnect at each HVAC unit. Fusing shall be per manufacturer's recommendation. Prior to wiring HVAC units, Contractor shall review submittals on equipment for electrical characteristics.

3.11 DATA SYSTEM

- A. Contractor shall furnish and install a fire rated plywood backboard for tel/data equipment as indicated on the drawings.

3.12 FIRE ALARM SYSTEM

A. INSTALLATION

1. Fire alarm system shall be wired in accordance with manufacturer's complete Wiring Diagram as submitted with Shop Drawings.
2. Low energy, plenum rated Power Limited Fire Alarm cable shall be utilized for wiring system components associated with the SLC's and NAC's.
3. Provide two complete Wiring Diagrams and maintenance manuals to be turned over to Owner. Provide one additional Wiring Diagram and maintenance manual in control panel.
4. Entire system shall be guaranteed for one year after final acceptance.
5. Provide and install the system in accordance with the Plans and Specifications, all applicable codes and the manufacturer's recommendations. All wiring shall be installed in strict compliance with all the provisions of NEC-Article 760 Power-Limited Fire Protective Signaling Circuits. Upon completion, the Contractor shall so certify in writing to the Owner and General Contractor. All junction boxes shall be painted red and labeled "Fire Alarm". Wiring color code shall be maintained throughout the installation.
6. All junction boxes shall be painted RED and labeled "Fire Alarm". Wiring color code shall be maintained throughout the installation.
7. Installation of equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate Subcontractors.
8. The Contractor shall clean all dirt and debris from the inside and the outside of the fire alarm equipment after completion of the installation.
9. The manufacturer's authorized representative shall provide onsite supervision of installation.
10. The contractor shall coordinate with local Fire Department the naming of addressable points and zones prior to programming

B. TESTING

1. The completed fire alarm system shall be fully tested in accordance with NFPA-72H by the Contractor in the presence of Owner's Representative and the Local Fire Marshall. Upon completion of a successful test, the Contractor shall so certify in writing to the Owner and General Contractor.

C. TRAINING

1. Contractor shall provide one hour of on site training for the local fire department

D. WARRANTY

1. The Contractor shall warrant the completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of one year from the date of first beneficial use.
2. The equipment manufacturer shall make available to the Owner a maintenance contract proposal to provide a minimum of two inspections and tests per year in compliance with NFPA-72H guidelines.

E. GENERAL

1. The work covered by this Section of the Specifications includes the furnishing of all labor, equipment, materials, and performance of all operations in connection with the installation of the Fire Alarm System as shown on the Drawings and as herein specified.
2. The requirements of the conditions of the Contract, Supplementary conditions and General Requirements apply to the work specified in this Section.
3. The complete installation shall conform to the applicable sections of NFPA-72, Local Code Requirements and National Electrical Code with particular attention to Article 760.
4. The work covered by this Section of the Specifications shall be coordinated with the related work as specified elsewhere under the project Specifications.

F. QUALITY ASSURANCE

1. Each and all items of the fire Alarm System shall be listed as a product of a SINGLE fire alarm system manufacturer under the appropriate category by Underwriters' Laboratories, Inc. (UL), and shall bear the "U.L." label. All control equipment shall be listed under UL category UOJZ as a single control unit. Partial listing shall not be acceptable.
2. In addition to the UL-UOJZ requirement mentioned above, the system controls shall be UL listed for Power Limited Applications per NEC 760. All circuits must be marked in accordance with NEC Article 760.

- G.** The Electrical Contractor shall furnish and install in accordance with manufacturer's instructions all wiring, conduit, and outlet boxes required for the erection of a complete system as described herein and as indicated on the Drawings.

- H.** All wiring shall be as indicated above, and shall meet the requirements of all National, State, and Local Electrical Codes. The sizes of the different wires shall be as specified by the manufacturer. Color code shall be used throughout. All wires shall be tagged at all junction points and shall test free from grounds or crosses between the conductors.

- I.** Final connections between the control equipment and wiring system shall be made under direct supervision of a representative of the manufacturer.

3.13 QUIET OPERATION

- A.** All equipment and material furnished by this Contractor shall operate under all conditions of load without objectionable noise or vibration, which in the opinion

of the Architect is objectionable. Where sound or vibration conditions occur, which the Architect considers objectionable, this Contractor shall eliminate same in a manner approved by the Architect.

3.14 RECORD DRAWINGS

- A. A set of as-built Record Drawings, consisting of an electronic version of the Drawings with additional sketches as required, denoting and dimensioning accurately all changes in elevation location and size of material deviating from the Architect's Drawings, shall be kept concurrently with the progress of the installation. Upon completion of the work, the Contractor shall deliver to the Architect an electronic copy of the up-to-date, as-built, Record Drawings.

3.15 SUPPLEMENTARY STEEL, CHANNELS AND SUPPORTS

- A. Supplementary steel and channels shall be firmly connected to building construction in a manner approved by the Architect prior to the installation of same. The Electrical Contractor shall submit to the Architect, via the General Contractor the location where he proposes to use supplementary steel and channels, for the support of equipment, fixtures, and raceways. The submittal shall indicate the mounting methods, size, and details of the supports, channels, and steel. It shall also indicate the weight, which the supports, channels and supplementary steel are to carry.

APPENDIX B:
PREVAILING WAGE DOCUMENTS



MAURA HEALEY
Governor

KIM DRISCOLL
Lt. Governor

THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF LABOR AND WORKFORCE DEVELOPMENT
DEPARTMENT OF LABOR STANDARDS

Prevailing Wage Rates

As determined by the Director under the provisions of the
Massachusetts General Laws, Chapter 149, Sections 26 to 27H

LAUREN JONES
Secretary

MICHAEL FLANAGAN
Director

Awarding Authority: Town of Sharon
Contract Number: **City/Town:** SHARON
Description of Work: 955 sf Renovation to the historical Sharon Water Dept Building includ office areas and MEP upgrades.
Job Location: 5 Upland Road, Sharon, MA 02067

Information about Prevailing Wage Schedules for Awarding Authorities and Contractors

- **The wage rates will remain in effect for the duration of the project, except in the case of multi-year public construction projects. For construction projects lasting longer than one year, awarding authorities must request an updated wage schedule no later than two weeks before the anniversary of the date the contract was executed by the awarding authority and the general contractor.** For multi-year CM AT RISK projects, the awarding authority must request an annual update no later than two weeks before the anniversary date, determined as the earlier of: (a) the execution date of the GMP Amendment, or (b) the execution date of the first amendment to permit procurement of construction services. The annual update requirement is not applicable to 27F "rental of equipment" contracts. **The updated wage schedule must be provided to all contractors, including general and sub-contractors, working on the construction project.**
- This wage schedule applies only to the specific project referenced at the top of this page and uniquely identified by the "Wage Request Number" on all pages of this schedule.
- An Awarding Authority must request an updated wage schedule if it has not opened bids or selected a contractor within 90 days of the date of issuance of the wage schedule. For CM AT RISK projects (bid pursuant to G.L. c.149A), the earlier of: (a) the execution date of the GMP Amendment, or (b) the bid for the first construction scope of work must be within 90-days of the wage schedule issuance date.
- The wage schedule shall be incorporated in any advertisement or call for bids for the project as required by M.G.L. c. 149, § 27. The wage schedule shall be made a part of the contract awarded for the project. The wage schedule must be posted in a conspicuous place at the work site for the life of the project in accordance with M.G.L. c. 149 § 27. The wages listed on the wage schedule must be paid to employees performing construction work on the project whether they are employed by the prime contractor, a filed sub-bidder, or a sub-contractor.
- Apprentices working on the project are required to be registered with the Massachusetts Division of Apprentice Standards (DAS). Apprentices must keep their apprentice identification card on their persons during all work hours on the project. An apprentice registered with DAS may be paid the lower apprentice wage rate at the applicable step as provided on the prevailing wage schedule. **Any apprentice not registered with DAS regardless of whether they are registered with another federal, state, local, or private agency must be paid the journeyworker's rate.**
- Every contractor or subcontractor working on the construction project must submit weekly payroll reports and a Statement of Compliance directly to the awarding authority by mail or email and keep them on file for three years. Each weekly payroll report must contain: the employee's name, address, occupational classification, hours worked, and wages paid. Do not submit weekly payroll reports to DLS. For a sample payroll reporting form go to <http://www.mass.gov/dols/pw>.
- Contractors with questions about the wage rates or classifications included on the wage schedule have an affirmative obligation to inquire with DLS at (617) 626-6953.
- Contractors must obtain the wage schedules from awarding authorities. Failure of a contractor or subcontractor to pay the prevailing wage rates listed on the wage schedule to all employees who perform construction work on the project is a violation of the law and subjects the contractor or subcontractor to civil and criminal penalties.
- Employees not receiving the prevailing wage rate set forth on the wage schedule may file a complaint with the Fair Labor Division of the office of the Attorney General at (617) 727-3465.

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
Construction						
(2 AXLE) DRIVER - EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2023	\$38.95	\$14.57	\$17.29	\$0.00	\$70.81
	12/01/2023	\$38.95	\$14.57	\$18.67	\$0.00	\$72.19
	01/01/2024	\$38.95	\$15.07	\$18.67	\$0.00	\$72.69
	06/01/2024	\$39.95	\$15.07	\$18.67	\$0.00	\$73.69
	12/01/2024	\$39.95	\$15.07	\$20.17	\$0.00	\$75.19
	01/01/2025	\$39.95	\$15.57	\$20.17	\$0.00	\$75.69
	06/01/2025	\$40.95	\$15.57	\$20.17	\$0.00	\$76.69
	12/01/2025	\$40.95	\$15.57	\$21.78	\$0.00	\$78.30
	01/01/2026	\$40.95	\$16.17	\$21.78	\$0.00	\$78.90
	06/01/2026	\$41.95	\$16.17	\$21.78	\$0.00	\$79.90
	12/01/2026	\$41.95	\$16.17	\$23.52	\$0.00	\$81.64
	01/01/2027	\$41.95	\$16.77	\$23.52	\$0.00	\$82.24
(3 AXLE) DRIVER - EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2023	\$39.02	\$14.57	\$17.29	\$0.00	\$70.88
	12/01/2023	\$39.02	\$14.57	\$18.67	\$0.00	\$72.26
	01/01/2024	\$39.02	\$15.07	\$18.67	\$0.00	\$72.76
	06/01/2024	\$40.02	\$15.07	\$18.67	\$0.00	\$73.76
	12/01/2024	\$40.02	\$15.07	\$20.17	\$0.00	\$75.26
	01/01/2025	\$40.02	\$15.57	\$20.17	\$0.00	\$75.76
	06/01/2025	\$41.02	\$15.57	\$20.17	\$0.00	\$76.76
	12/01/2025	\$41.02	\$15.57	\$21.78	\$0.00	\$78.37
	01/01/2026	\$41.02	\$16.17	\$21.78	\$0.00	\$78.97
	06/01/2026	\$42.02	\$16.17	\$21.78	\$0.00	\$79.97
	12/01/2026	\$42.02	\$16.17	\$23.52	\$0.00	\$81.71
	01/01/2027	\$42.02	\$16.77	\$23.52	\$0.00	\$82.31
(4 & 5 AXLE) DRIVER - EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2023	\$39.14	\$14.57	\$17.29	\$0.00	\$71.00
	12/01/2023	\$39.14	\$14.57	\$18.67	\$0.00	\$72.38
	01/01/2024	\$39.14	\$15.07	\$18.67	\$0.00	\$72.88
	06/01/2024	\$40.14	\$15.07	\$18.67	\$0.00	\$73.88
	12/01/2024	\$40.14	\$15.07	\$20.17	\$0.00	\$75.38
	01/01/2025	\$40.14	\$15.57	\$20.17	\$0.00	\$75.88
	06/01/2025	\$41.14	\$15.57	\$20.17	\$0.00	\$76.88
	12/01/2025	\$41.14	\$15.57	\$21.78	\$0.00	\$78.49
	01/01/2026	\$41.14	\$16.17	\$21.78	\$0.00	\$79.09
	06/01/2026	\$42.14	\$16.17	\$21.78	\$0.00	\$80.09
	12/01/2026	\$42.14	\$16.17	\$23.52	\$0.00	\$81.83
	01/01/2027	\$42.14	\$16.77	\$23.52	\$0.00	\$82.43
ADS/SUBMERSIBLE PILOT <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$103.05	\$9.40	\$23.12	\$0.00	\$135.57
For apprentice rates see "Apprentice- PILE DRIVER"						
AIR TRACK OPERATOR <i>LABORERS - ZONE 2</i>	06/01/2023	\$38.21	\$9.40	\$16.89	\$0.00	\$64.50
	12/01/2023	\$39.11	\$9.40	\$16.89	\$0.00	\$65.40
For apprentice rates see "Apprentice- LABORER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
AIR TRACK OPERATOR (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY & HIGHWAY)</i>	06/01/2023	\$38.21	\$9.40	\$16.89	\$0.00	\$64.50
	12/01/2023	\$39.11	\$9.40	\$16.89	\$0.00	\$65.40
	06/01/2024	\$40.44	\$9.40	\$16.89	\$0.00	\$66.73
	12/01/2024	\$41.77	\$9.40	\$16.89	\$0.00	\$68.06
	06/01/2025	\$43.16	\$9.40	\$16.89	\$0.00	\$69.45
	12/01/2025	\$44.54	\$9.40	\$16.89	\$0.00	\$70.83
	06/01/2026	\$45.98	\$9.40	\$16.89	\$0.00	\$72.27
	12/01/2026	\$47.42	\$9.40	\$16.89	\$0.00	\$73.71
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)						
ASBESTOS REMOVER - PIPE / MECH. EQUIPT. <i>HEAT & FROST INSULATORS LOCAL 6 (BOSTON)</i>	06/01/2023	\$39.80	\$14.50	\$11.05	\$0.00	\$65.35
	12/01/2023	\$40.80	\$14.50	\$11.05	\$0.00	\$66.35
	06/01/2024	\$41.80	\$14.50	\$11.05	\$0.00	\$67.35
	12/01/2024	\$42.80	\$14.50	\$11.05	\$0.00	\$68.35
	06/01/2025	\$43.80	\$14.50	\$11.05	\$0.00	\$69.35
	12/01/2025	\$44.80	\$14.50	\$11.05	\$0.00	\$70.35
ASPHALT RAKER <i>LABORERS - ZONE 2</i>	06/01/2023	\$37.71	\$9.40	\$16.89	\$0.00	\$64.00
	12/01/2023	\$38.61	\$9.40	\$16.89	\$0.00	\$64.90
For apprentice rates see "Apprentice- LABORER"						
ASPHALT RAKER (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY & HIGHWAY)</i>	06/01/2023	\$37.71	\$9.40	\$16.89	\$0.00	\$64.00
	12/01/2023	\$38.61	\$9.40	\$16.89	\$0.00	\$64.90
	06/01/2024	\$39.94	\$9.40	\$16.89	\$0.00	\$66.23
	12/01/2024	\$41.27	\$9.40	\$16.89	\$0.00	\$67.56
	06/01/2025	\$42.66	\$9.40	\$16.89	\$0.00	\$68.95
	12/01/2025	\$44.04	\$9.40	\$16.89	\$0.00	\$70.33
	06/01/2026	\$45.48	\$9.40	\$16.89	\$0.00	\$71.77
	12/01/2026	\$46.92	\$9.40	\$16.89	\$0.00	\$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)						
ASPHALT/CONCRETE/CRUSHER PLANT-ON SITE <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2023	\$54.28	\$14.75	\$16.15	\$0.00	\$85.18
	12/01/2023	\$55.53	\$14.75	\$16.15	\$0.00	\$86.43
	06/01/2024	\$56.83	\$14.75	\$16.15	\$0.00	\$87.73
	12/01/2024	\$58.28	\$14.75	\$16.15	\$0.00	\$89.18
	06/01/2025	\$59.58	\$14.75	\$16.15	\$0.00	\$90.48
	12/01/2025	\$61.03	\$14.75	\$16.15	\$0.00	\$91.93
	06/01/2026	\$62.33	\$14.75	\$16.15	\$0.00	\$93.23
	12/01/2026	\$63.78	\$14.75	\$16.15	\$0.00	\$94.68
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
BACKHOE/FRONT-END LOADER <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2023	\$54.28	\$14.75	\$16.15	\$0.00	\$85.18
	12/01/2023	\$55.53	\$14.75	\$16.15	\$0.00	\$86.43
	06/01/2024	\$56.83	\$14.75	\$16.15	\$0.00	\$87.73
	12/01/2024	\$58.28	\$14.75	\$16.15	\$0.00	\$89.18
	06/01/2025	\$59.58	\$14.75	\$16.15	\$0.00	\$90.48
	12/01/2025	\$61.03	\$14.75	\$16.15	\$0.00	\$91.93
	06/01/2026	\$62.33	\$14.75	\$16.15	\$0.00	\$93.23
	12/01/2026	\$63.78	\$14.75	\$16.15	\$0.00	\$94.68
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
BARCO-TYPE JUMPING TAMPER <i>LABORERS - ZONE 2</i>	06/01/2023	\$37.71	\$9.40	\$16.89	\$0.00	\$64.00
	12/01/2023	\$38.61	\$9.40	\$16.89	\$0.00	\$64.90
For apprentice rates see "Apprentice- LABORER"						
BLOCK PAVER, RAMMER / CURB SETTER <i>LABORERS - ZONE 2</i>	06/01/2023	\$38.21	\$9.40	\$16.89	\$0.00	\$64.50
	12/01/2023	\$39.11	\$9.40	\$16.89	\$0.00	\$65.40
For apprentice rates see "Apprentice- LABORER"						
BLOCK PAVER, RAMMER / CURB SETTER (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY & HIGHWAY)</i>	06/01/2023	\$38.21	\$9.40	\$16.89	\$0.00	\$64.50
	12/01/2023	\$39.11	\$9.40	\$16.89	\$0.00	\$65.40
	06/01/2024	\$40.44	\$9.40	\$16.89	\$0.00	\$66.73
	12/01/2024	\$41.77	\$9.40	\$16.89	\$0.00	\$68.06
	06/01/2025	\$43.16	\$9.40	\$16.89	\$0.00	\$69.45
	12/01/2025	\$44.54	\$9.40	\$16.89	\$0.00	\$70.83
	06/01/2026	\$45.98	\$9.40	\$16.89	\$0.00	\$72.27
	12/01/2026	\$47.42	\$9.40	\$16.89	\$0.00	\$73.71
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
BOILER MAKER <i>BOILERMAKERS LOCAL 29</i>	01/01/2023	\$47.37	\$7.07	\$20.31	\$0.00	\$74.75
	01/01/2024	\$48.12	\$7.07	\$20.60	\$0.00	\$75.79

Apprentice - BOILERMAKER - Local 29

Effective Date - 01/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	65	\$30.79	\$7.07	\$13.22	\$0.00	\$51.08
2	65	\$30.79	\$7.07	\$13.22	\$0.00	\$51.08
3	70	\$33.16	\$7.07	\$14.23	\$0.00	\$54.46
4	75	\$35.53	\$7.07	\$15.24	\$0.00	\$57.84
5	80	\$37.90	\$7.07	\$16.25	\$0.00	\$61.22
6	85	\$40.26	\$7.07	\$17.28	\$0.00	\$64.61
7	90	\$42.63	\$7.07	\$18.28	\$0.00	\$67.98
8	95	\$45.00	\$7.07	\$19.32	\$0.00	\$71.39

Effective Date - 01/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	65	\$31.28	\$7.07	\$13.22	\$0.00	\$51.57
2	65	\$31.28	\$7.07	\$13.22	\$0.00	\$51.57
3	70	\$33.68	\$7.07	\$14.23	\$0.00	\$54.98
4	75	\$36.09	\$7.07	\$15.24	\$0.00	\$58.40
5	80	\$38.50	\$7.07	\$16.25	\$0.00	\$61.82
6	85	\$40.90	\$7.07	\$17.28	\$0.00	\$65.25
7	90	\$43.31	\$7.07	\$18.28	\$0.00	\$68.66
8	95	\$45.71	\$7.07	\$19.32	\$0.00	\$72.10

Notes:

Apprentice to Journeyworker Ratio:1:4

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
BRICK/STONE/ARTIFICIAL MASONRY (INCL. MASONRY WATERPROOFING) <i>BRICKLAYERS LOCAL 3 (FOXBORO)</i>	08/01/2023	\$60.26	\$11.49	\$21.65	\$0.00	\$93.40
	02/01/2024	\$61.51	\$11.49	\$21.65	\$0.00	\$94.65
	08/01/2024	\$63.61	\$11.49	\$21.65	\$0.00	\$96.75
	02/01/2025	\$64.91	\$11.49	\$21.65	\$0.00	\$98.05
	08/01/2025	\$67.06	\$11.49	\$21.65	\$0.00	\$100.20
	02/01/2026	\$68.41	\$11.49	\$21.65	\$0.00	\$101.55
	08/01/2026	\$70.61	\$11.49	\$21.65	\$0.00	\$103.75
	02/01/2027	\$72.01	\$11.49	\$21.65	\$0.00	\$105.15

Apprentice - BRICK/PLASTER/CEMENT MASON - Local 3 Foxboro

Effective Date - 08/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$30.13	\$11.49	\$21.65	\$0.00	\$63.27
2	60	\$36.16	\$11.49	\$21.65	\$0.00	\$69.30
3	70	\$42.18	\$11.49	\$21.65	\$0.00	\$75.32
4	80	\$48.21	\$11.49	\$21.65	\$0.00	\$81.35
5	90	\$54.23	\$11.49	\$21.65	\$0.00	\$87.37

Effective Date - 02/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$30.76	\$11.49	\$21.65	\$0.00	\$63.90
2	60	\$36.91	\$11.49	\$21.65	\$0.00	\$70.05
3	70	\$43.06	\$11.49	\$21.65	\$0.00	\$76.20
4	80	\$49.21	\$11.49	\$21.65	\$0.00	\$82.35
5	90	\$55.36	\$11.49	\$21.65	\$0.00	\$88.50

Notes:

Apprentice to Journeyworker Ratio:1:5

BULLDOZER/GRADER/SCRAPER <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2023	\$53.69	\$14.75	\$16.15	\$0.00	\$84.59
	12/01/2023	\$54.93	\$14.75	\$16.15	\$0.00	\$85.83
	06/01/2024	\$56.21	\$14.75	\$16.15	\$0.00	\$87.11
	12/01/2024	\$57.65	\$14.75	\$16.15	\$0.00	\$88.55
	06/01/2025	\$58.93	\$14.75	\$16.15	\$0.00	\$89.83
	12/01/2025	\$60.37	\$14.75	\$16.15	\$0.00	\$91.27
	06/01/2026	\$61.65	\$14.75	\$16.15	\$0.00	\$92.55
	12/01/2026	\$63.09	\$14.75	\$16.15	\$0.00	\$93.99

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
CAISSON & UNDERPINNING BOTTOM MAN <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2023	\$44.73	\$9.40	\$17.97	\$0.00	\$72.10
	12/01/2023	\$45.98	\$9.40	\$17.97	\$0.00	\$73.35
	06/01/2024	\$47.46	\$9.40	\$17.97	\$0.00	\$74.83
	12/01/2024	\$48.93	\$9.40	\$17.97	\$0.00	\$76.30
	06/01/2025	\$50.43	\$9.40	\$17.97	\$0.00	\$77.80
	12/01/2025	\$51.93	\$9.40	\$17.97	\$0.00	\$79.30
	06/01/2026	\$53.48	\$9.40	\$17.97	\$0.00	\$80.85
	12/01/2026	\$54.98	\$9.40	\$17.97	\$0.00	\$82.35
For apprentice rates see "Apprentice- LABORER"						
CAISSON & UNDERPINNING LABORER <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2023	\$43.58	\$9.40	\$17.97	\$0.00	\$70.95
	12/01/2023	\$44.83	\$9.40	\$17.97	\$0.00	\$72.20
	06/01/2024	\$46.31	\$9.40	\$17.97	\$0.00	\$73.68
	12/01/2024	\$47.78	\$9.40	\$17.97	\$0.00	\$75.15
	06/01/2025	\$49.28	\$9.40	\$17.97	\$0.00	\$76.65
	12/01/2025	\$50.78	\$9.40	\$17.97	\$0.00	\$78.15
	06/01/2026	\$52.33	\$9.40	\$17.97	\$0.00	\$79.70
	12/01/2026	\$53.83	\$9.40	\$17.97	\$0.00	\$81.20
For apprentice rates see "Apprentice- LABORER"						
CAISSON & UNDERPINNING TOP MAN <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2023	\$43.58	\$9.40	\$17.97	\$0.00	\$70.95
	12/01/2023	\$44.83	\$9.40	\$17.97	\$0.00	\$72.20
	06/01/2024	\$46.31	\$9.40	\$17.97	\$0.00	\$73.68
	12/01/2024	\$47.78	\$9.40	\$17.97	\$0.00	\$75.15
	06/01/2025	\$49.28	\$9.40	\$17.97	\$0.00	\$76.65
	12/01/2025	\$50.78	\$9.40	\$17.97	\$0.00	\$78.15
	06/01/2026	\$52.33	\$9.40	\$17.97	\$0.00	\$79.70
	12/01/2026	\$53.83	\$9.40	\$17.97	\$0.00	\$81.20
For apprentice rates see "Apprentice- LABORER"						
CARBIDE CORE DRILL OPERATOR <i>LABORERS - ZONE 2</i>	06/01/2023	\$37.71	\$9.40	\$16.89	\$0.00	\$64.00
	12/01/2023	\$38.61	\$9.40	\$16.89	\$0.00	\$64.90
For apprentice rates see "Apprentice- LABORER"						
CARPENTER <i>CARPENTERS -ZONE 2 (Eastern Massachusetts)</i>	03/01/2023	\$45.12	\$9.33	\$19.97	\$0.00	\$74.42

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - CARPENTER - Zone 2 Eastern MA

Effective Date - 03/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$22.56	\$9.33	\$1.73	\$0.00	\$33.62
2	60	\$27.07	\$9.33	\$1.73	\$0.00	\$38.13
3	70	\$31.58	\$9.33	\$14.78	\$0.00	\$55.69
4	75	\$33.84	\$9.33	\$14.78	\$0.00	\$57.95
5	80	\$36.10	\$9.33	\$16.51	\$0.00	\$61.94
6	80	\$36.10	\$9.33	\$16.51	\$0.00	\$61.94
7	90	\$40.61	\$9.33	\$18.24	\$0.00	\$68.18
8	90	\$40.61	\$9.33	\$18.24	\$0.00	\$68.18

Notes:

% Indentured After 10/1/17; 45/45/55/55/70/70/80/80
 Step 1&2 \$30.71/ 3&4 \$36.93/ 5&6 \$56.82/ 7&8 \$63.06

Apprentice to Journeyworker Ratio:1:5

CARPENTER WOOD FRAME CARPENTERS-ZONE 3 (Wood Frame)	04/01/2023	\$24.16	\$7.21	\$4.80	\$0.00	\$36.17
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All Aspects of New Wood Frame Work

Apprentice - CARPENTER (Wood Frame) - Zone 3

Effective Date - 04/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$14.50	\$7.21	\$0.00	\$0.00	\$21.71
2	60	\$14.50	\$7.21	\$0.00	\$0.00	\$21.71
3	65	\$15.70	\$7.21	\$0.00	\$0.00	\$22.91
4	70	\$16.91	\$7.21	\$0.00	\$0.00	\$24.12
5	75	\$18.12	\$7.21	\$3.80	\$0.00	\$29.13
6	80	\$19.33	\$7.21	\$3.80	\$0.00	\$30.34
7	85	\$20.54	\$7.21	\$3.80	\$0.00	\$31.55
8	90	\$21.74	\$7.21	\$3.80	\$0.00	\$32.75

Notes:

% Indentured After 10/1/17; 45/45/55/55/70/70/80/80
 Step 1&2 \$17.86/ 3&4 \$20.22/ 5&6 \$27.57/ 7&8 \$29.94

Apprentice to Journeyworker Ratio:1:5

CEMENT MASONRY/PLASTERING BRICKLAYERS LOCAL 3 (FOXBORO)	07/01/2023	\$48.19	\$13.00	\$23.57	\$1.30	\$86.06
	01/01/2024	\$49.33	\$13.00	\$23.57	\$1.30	\$87.20

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - CEMENT MASONRY/PLASTERING - Foxboro

Effective Date - 07/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$24.10	\$13.00	\$15.93	\$0.00	\$53.03
2	60	\$28.91	\$13.00	\$18.57	\$1.30	\$61.78
3	65	\$31.32	\$13.00	\$19.57	\$1.30	\$65.19
4	70	\$33.73	\$13.00	\$20.57	\$1.30	\$68.60
5	75	\$36.14	\$13.00	\$21.57	\$1.30	\$72.01
6	80	\$38.55	\$13.00	\$22.57	\$1.30	\$75.42
7	90	\$43.37	\$13.00	\$23.57	\$1.30	\$81.24

Effective Date - 01/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$24.67	\$13.00	\$15.93	\$0.00	\$53.60
2	60	\$29.60	\$13.00	\$18.57	\$1.30	\$62.47
3	65	\$32.06	\$13.00	\$19.57	\$1.30	\$65.93
4	70	\$34.53	\$13.00	\$20.57	\$1.30	\$69.40
5	75	\$37.00	\$13.00	\$21.57	\$1.30	\$72.87
6	80	\$39.46	\$13.00	\$22.57	\$1.30	\$76.33
7	90	\$44.40	\$13.00	\$23.57	\$1.30	\$82.27

Notes:

Steps 3,4 are 500 hrs. All other steps are 1,000 hrs.

Apprentice to Journeyworker Ratio:1:3

CHAIN SAW OPERATOR	06/01/2023	\$37.71	\$9.40	\$16.89	\$0.00	\$64.00
LABORERS - ZONE 2	12/01/2023	\$38.61	\$9.40	\$16.89	\$0.00	\$64.90

For apprentice rates see "Apprentice- LABORER"

CLAM SHELLS/SLURRY BUCKETS/HEADING MACHINES	06/01/2023	\$55.35	\$14.75	\$16.15	\$0.00	\$86.25
OPERATING ENGINEERS LOCAL 4	12/01/2023	\$56.63	\$14.75	\$16.15	\$0.00	\$87.53
	06/01/2024	\$57.95	\$14.75	\$16.15	\$0.00	\$88.85
	12/01/2024	\$59.43	\$14.75	\$16.15	\$0.00	\$90.33
	06/01/2025	\$60.76	\$14.75	\$16.15	\$0.00	\$91.66
	12/01/2025	\$62.23	\$14.75	\$16.15	\$0.00	\$93.13
	06/01/2026	\$63.56	\$14.75	\$16.15	\$0.00	\$94.46
	12/01/2026	\$65.04	\$14.75	\$16.15	\$0.00	\$95.94

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

COMPRESSOR OPERATOR	06/01/2023	\$35.30	\$14.75	\$16.15	\$0.00	\$66.20
OPERATING ENGINEERS LOCAL 4	12/01/2023	\$36.12	\$14.75	\$16.15	\$0.00	\$67.02
	06/01/2024	\$36.97	\$14.75	\$16.15	\$0.00	\$67.87
	12/01/2024	\$37.92	\$14.75	\$16.15	\$0.00	\$68.82
	06/01/2025	\$38.77	\$14.75	\$16.15	\$0.00	\$69.67
	12/01/2025	\$39.72	\$14.75	\$16.15	\$0.00	\$70.62
	06/01/2026	\$40.58	\$14.75	\$16.15	\$0.00	\$71.48
	12/01/2026	\$41.53	\$14.75	\$16.15	\$0.00	\$72.43

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
DELEADER (BRIDGE) PAINTERS LOCAL 35 - ZONE 2	07/01/2023	\$55.51	\$9.65	\$23.70	\$0.00	\$88.86
	01/01/2024	\$56.06	\$9.95	\$23.95	\$0.00	\$89.96
	07/01/2024	\$57.26	\$9.95	\$23.95	\$0.00	\$91.16
	01/01/2025	\$58.46	\$9.95	\$23.95	\$0.00	\$92.36

Apprentice - PAINTER Local 35 - BRIDGES/TANKS

Effective Date - 07/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$27.76	\$9.65	\$0.00	\$0.00	\$37.41
2	55	\$30.53	\$9.65	\$6.55	\$0.00	\$46.73
3	60	\$33.31	\$9.65	\$7.14	\$0.00	\$50.10
4	65	\$36.08	\$9.65	\$7.74	\$0.00	\$53.47
5	70	\$38.86	\$9.65	\$20.13	\$0.00	\$68.64
6	75	\$41.63	\$9.65	\$20.73	\$0.00	\$72.01
7	80	\$44.41	\$9.65	\$21.32	\$0.00	\$75.38
8	90	\$49.96	\$9.65	\$22.51	\$0.00	\$82.12

Effective Date - 01/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$28.03	\$9.95	\$0.00	\$0.00	\$37.98
2	55	\$30.83	\$9.95	\$6.66	\$0.00	\$47.44
3	60	\$33.64	\$9.95	\$7.26	\$0.00	\$50.85
4	65	\$36.44	\$9.95	\$7.87	\$0.00	\$54.26
5	70	\$39.24	\$9.95	\$20.32	\$0.00	\$69.51
6	75	\$42.05	\$9.95	\$20.93	\$0.00	\$72.93
7	80	\$44.85	\$9.95	\$21.53	\$0.00	\$76.33
8	90	\$50.45	\$9.95	\$22.74	\$0.00	\$83.14

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

DEMO: ADZEMAN LABORERS - ZONE 2	06/01/2023	\$43.73	\$9.40	\$17.82	\$0.00	\$70.95
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For apprentice rates see "Apprentice- LABORER"

DEMO: BACKHOE/LOADER/HAMMER OPERATOR LABORERS - ZONE 2	06/01/2023	\$44.73	\$9.40	\$17.82	\$0.00	\$71.95
	12/01/2023	\$45.98	\$9.40	\$17.82	\$0.00	\$73.20

For apprentice rates see "Apprentice- LABORER"

DEMO: BURNERS LABORERS - ZONE 2	06/01/2023	\$44.48	\$9.40	\$17.82	\$0.00	\$71.70
	12/01/2023	\$45.73	\$9.40	\$17.82	\$0.00	\$72.95

For apprentice rates see "Apprentice- LABORER"

DEMO: CONCRETE CUTTER/SAWYER LABORERS - ZONE 2	06/01/2023	\$44.73	\$9.40	\$17.82	\$0.00	\$71.95
	12/01/2023	\$45.98	\$9.40	\$17.82	\$0.00	\$73.20

For apprentice rates see "Apprentice- LABORER"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
DEMO: JACKHAMMER OPERATOR <i>LABORERS - ZONE 2</i>	06/01/2023	\$44.48	\$9.40	\$17.82	\$0.00	\$71.70
	12/01/2023	\$45.73	\$9.40	\$17.82	\$0.00	\$72.95
For apprentice rates see "Apprentice- LABORER"						
DEMO: WRECKING LABORER <i>LABORERS - ZONE 2</i>	06/01/2023	\$43.73	\$9.40	\$17.82	\$0.00	\$70.95
	12/01/2023	\$44.98	\$9.40	\$17.82	\$0.00	\$72.20
For apprentice rates see "Apprentice- LABORER"						
DIRECTIONAL DRILL MACHINE OPERATOR <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2023	\$53.69	\$14.75	\$16.15	\$0.00	\$84.59
	12/01/2023	\$54.93	\$14.75	\$16.15	\$0.00	\$85.83
	06/01/2024	\$56.21	\$14.75	\$16.15	\$0.00	\$87.11
	12/01/2024	\$57.65	\$14.75	\$16.15	\$0.00	\$88.55
	06/01/2025	\$58.93	\$14.75	\$16.15	\$0.00	\$89.83
	12/01/2025	\$60.37	\$14.75	\$16.15	\$0.00	\$91.27
	06/01/2026	\$61.65	\$14.75	\$16.15	\$0.00	\$92.55
	12/01/2026	\$63.09	\$14.75	\$16.15	\$0.00	\$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
DIVER <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$68.70	\$9.40	\$23.12	\$0.00	\$101.22
For apprentice rates see "Apprentice- PILE DRIVER"						
DIVER TENDER <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$49.07	\$9.40	\$23.12	\$0.00	\$81.59
For apprentice rates see "Apprentice- PILE DRIVER"						
DIVER TENDER (EFFLUENT) <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$73.60	\$9.40	\$23.12	\$0.00	\$106.12
For apprentice rates see "Apprentice- PILE DRIVER"						
DIVER/SLURRY (EFFLUENT) <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$103.05	\$9.40	\$23.12	\$0.00	\$135.57
For apprentice rates see "Apprentice- PILE DRIVER"						
DRAWBRIDGE OPERATOR (Construction) <i>DRAWBRIDGE - SEIU LOCAL 888</i>	07/01/2020	\$26.77	\$6.67	\$3.93	\$0.16	\$37.53
ELECTRICIAN <i>ELECTRICIANS LOCAL 103</i>	03/01/2023	\$59.23	\$13.00	\$21.63	\$0.00	\$93.86

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - ELECTRICIAN - Local 103

Effective Date - 03/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$23.69	\$13.00	\$0.71	\$0.00	\$37.40
2	40	\$23.69	\$13.00	\$0.71	\$0.00	\$37.40
3	45	\$26.65	\$13.00	\$16.13	\$0.00	\$55.78
4	45	\$26.65	\$13.00	\$16.13	\$0.00	\$55.78
5	50	\$29.62	\$13.00	\$16.63	\$0.00	\$59.25
6	55	\$32.58	\$13.00	\$17.13	\$0.00	\$62.71
7	60	\$35.54	\$13.00	\$17.63	\$0.00	\$66.17
8	65	\$38.50	\$13.00	\$18.13	\$0.00	\$69.63
9	70	\$41.46	\$13.00	\$18.62	\$0.00	\$73.08
10	75	\$44.42	\$13.00	\$19.13	\$0.00	\$76.55

Notes:
App Prior 1/1/03; 30/35/40/45/50/55/65/70/75/80

Apprentice to Journeyworker Ratio:2:3***

ELEVATOR CONSTRUCTOR ELEVATOR CONSTRUCTORS LOCAL 4	01/01/2022	\$65.62	\$16.03	\$20.21	\$0.00	\$101.86
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Apprentice - ELEVATOR CONSTRUCTOR - Local 4

Effective Date - 01/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$32.81	\$16.03	\$0.00	\$0.00	\$48.84
2	55	\$36.09	\$16.03	\$20.21	\$0.00	\$72.33
3	65	\$42.65	\$16.03	\$20.21	\$0.00	\$78.89
4	70	\$45.93	\$16.03	\$20.21	\$0.00	\$82.17
5	80	\$52.50	\$16.03	\$20.21	\$0.00	\$88.74

Notes:
Steps 1-2 are 6 mos.; Steps 3-5 are 1 year

Apprentice to Journeyworker Ratio:1:1

ELEVATOR CONSTRUCTOR HELPER ELEVATOR CONSTRUCTORS LOCAL 4	01/01/2022	\$45.93	\$16.03	\$20.21	\$0.00	\$82.17
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For apprentice rates see "Apprentice - ELEVATOR CONSTRUCTOR"

FENCE & GUARD RAIL ERECTOR (HEAVY & HIGHWAY) LABORERS - ZONE 2 (HEAVY & HIGHWAY)	06/01/2023	\$37.71	\$9.40	\$16.89	\$0.00	\$64.00
	12/01/2023	\$38.61	\$9.40	\$16.89	\$0.00	\$64.90
	06/01/2024	\$39.94	\$9.40	\$16.89	\$0.00	\$66.23
	12/01/2024	\$41.27	\$9.40	\$16.89	\$0.00	\$67.56
	06/01/2025	\$42.66	\$9.40	\$16.89	\$0.00	\$68.95
	12/01/2025	\$44.04	\$9.40	\$16.89	\$0.00	\$70.33
	06/01/2026	\$45.48	\$9.40	\$16.89	\$0.00	\$71.77
	12/01/2026	\$46.92	\$9.40	\$16.89	\$0.00	\$73.21

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)						
FIELD ENG.INST.PERSON-BLDG,SITE,HVY/HWY <i>OPERATING ENGINEERS LOCAL 4</i>	05/01/2023	\$49.06	\$14.50	\$16.15	\$0.00	\$79.71
	11/01/2023	\$50.30	\$14.50	\$16.15	\$0.00	\$80.95
	05/01/2024	\$51.54	\$14.50	\$16.15	\$0.00	\$82.19
	11/01/2024	\$52.83	\$14.50	\$16.15	\$0.00	\$83.48
	05/01/2025	\$54.27	\$14.50	\$16.15	\$0.00	\$84.92
	11/01/2025	\$55.56	\$14.50	\$16.15	\$0.00	\$86.21
	05/01/2026	\$57.00	\$14.50	\$16.15	\$0.00	\$87.65
	11/01/2026	\$58.29	\$14.50	\$16.15	\$0.00	\$88.94
	05/01/2027	\$59.72	\$14.50	\$16.15	\$0.00	\$90.37
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FIELD ENG.PARTY CHIEF-BLDG,SITE,HVY/HWY <i>OPERATING ENGINEERS LOCAL 4</i>	05/01/2023	\$50.62	\$14.50	\$16.15	\$0.00	\$81.27
	11/01/2023	\$51.87	\$14.50	\$16.15	\$0.00	\$82.52
	05/01/2024	\$53.12	\$14.50	\$16.15	\$0.00	\$83.77
	11/01/2024	\$54.42	\$14.50	\$16.15	\$0.00	\$85.07
	05/01/2025	\$55.87	\$14.50	\$16.15	\$0.00	\$86.52
	11/01/2025	\$57.17	\$14.50	\$16.15	\$0.00	\$87.82
	05/01/2026	\$58.62	\$14.50	\$16.15	\$0.00	\$89.27
	11/01/2026	\$59.92	\$14.50	\$16.15	\$0.00	\$90.57
	05/01/2027	\$61.37	\$14.50	\$16.15	\$0.00	\$92.02
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FIELD ENG.ROD PERSON-BLDG,SITE,HVY/HWY <i>OPERATING ENGINEERS LOCAL 4</i>	05/01/2023	\$24.20	\$14.50	\$16.15	\$0.00	\$54.85
	11/01/2023	\$24.93	\$14.50	\$16.15	\$0.00	\$55.58
	05/01/2024	\$25.66	\$14.50	\$16.15	\$0.00	\$56.31
	11/01/2024	\$26.42	\$14.50	\$16.15	\$0.00	\$57.07
	05/01/2025	\$27.27	\$14.50	\$16.15	\$0.00	\$57.92
	11/01/2025	\$28.03	\$14.50	\$16.15	\$0.00	\$58.68
	05/01/2026	\$28.88	\$14.50	\$16.15	\$0.00	\$59.53
	11/01/2026	\$29.64	\$14.50	\$16.15	\$0.00	\$60.29
	05/01/2027	\$30.49	\$14.50	\$16.15	\$0.00	\$61.14
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FIRE ALARM INSTALLER <i>ELECTRICIANS LOCAL 103</i>	03/01/2023	\$59.23	\$13.00	\$21.63	\$0.00	\$93.86
For apprentice rates see "Apprentice- ELECTRICIAN"						
FIRE ALARM REPAIR / MAINTENANCE / COMMISSIONING <i>ELECTRICIANS LOCAL 103</i>	03/01/2023	\$48.34	\$13.00	\$19.01	\$0.00	\$80.35
For apprentice rates see "Apprentice- TELECOMMUNICATIONS TECHNICIAN"						
FIREMAN (ASST. ENGINEER) <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2023	\$43.96	\$14.75	\$16.15	\$0.00	\$74.86
	12/01/2023	\$44.97	\$14.75	\$16.15	\$0.00	\$75.87
	06/01/2024	\$46.03	\$14.75	\$16.15	\$0.00	\$76.93
	12/01/2024	\$47.21	\$14.75	\$16.15	\$0.00	\$78.11
	06/01/2025	\$48.27	\$14.75	\$16.15	\$0.00	\$79.17
	12/01/2025	\$49.44	\$14.75	\$16.15	\$0.00	\$80.34
	06/01/2026	\$50.50	\$14.75	\$16.15	\$0.00	\$81.40
	12/01/2026	\$51.68	\$14.75	\$16.15	\$0.00	\$82.58
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
FLAGGER & SIGNALER (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY & HIGHWAY)</i>	06/01/2023	\$25.98	\$9.40	\$16.89	\$0.00	\$52.27
	12/01/2023	\$25.98	\$9.40	\$16.89	\$0.00	\$52.27
	06/01/2024	\$27.01	\$9.40	\$16.89	\$0.00	\$53.30
	12/01/2024	\$27.01	\$9.40	\$16.89	\$0.00	\$53.30
	06/01/2025	\$28.09	\$9.40	\$16.89	\$0.00	\$54.38
	12/01/2025	\$28.09	\$9.40	\$16.89	\$0.00	\$54.38
	06/01/2026	\$29.21	\$9.40	\$16.89	\$0.00	\$55.50
	12/01/2026	\$29.21	\$9.40	\$16.89	\$0.00	\$55.50

For apprentice rates see "Apprentice- LABORER (Heavy and Highway)

FLOORCOVERER <i>FLOORCOVERERS LOCAL 2168 ZONE 1</i>	03/01/2022	\$51.77	\$9.33	\$20.27	\$0.00	\$81.37
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Apprentice - FLOORCOVERER - Local 2168 Zone 1

Effective Date - 03/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$25.89	\$9.33	\$1.79	\$0.00	\$37.01
2	55	\$28.47	\$9.33	\$1.79	\$0.00	\$39.59
3	60	\$31.06	\$9.33	\$14.90	\$0.00	\$55.29
4	65	\$33.65	\$9.33	\$14.90	\$0.00	\$57.88
5	70	\$36.24	\$9.33	\$16.69	\$0.00	\$62.26
6	75	\$38.83	\$9.33	\$16.69	\$0.00	\$64.85
7	80	\$41.42	\$9.33	\$18.48	\$0.00	\$69.23
8	85	\$44.00	\$9.33	\$18.48	\$0.00	\$71.81

Notes: Steps are 750 hrs.
% After 10/1/17; 45/45/55/55/70/70/80/80 (1500hr Steps)
Step 1&2 \$32.94/ 3&4 \$39.66/ 5&6 \$60.32/ 7&8 \$67.10

Apprentice to Journeyworker Ratio:1:1

FORK LIFT/CHERRY PICKER <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2023	\$54.28	\$14.75	\$16.15	\$0.00	\$85.18
	12/01/2023	\$55.53	\$14.75	\$16.15	\$0.00	\$86.43
	06/01/2024	\$56.83	\$14.75	\$16.15	\$0.00	\$87.73
	12/01/2024	\$58.28	\$14.75	\$16.15	\$0.00	\$89.18
	06/01/2025	\$59.58	\$14.75	\$16.15	\$0.00	\$90.48
	12/01/2025	\$61.03	\$14.75	\$16.15	\$0.00	\$91.93
	06/01/2026	\$62.33	\$14.75	\$16.15	\$0.00	\$93.23
	12/01/2026	\$63.78	\$14.75	\$16.15	\$0.00	\$94.68

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

GENERATOR/LIGHTING PLANT/HEATERS <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2023	\$35.30	\$14.75	\$16.15	\$0.00	\$66.20
	12/01/2023	\$36.12	\$14.75	\$16.15	\$0.00	\$67.02
	06/01/2024	\$36.97	\$14.75	\$16.15	\$0.00	\$67.87
	12/01/2024	\$37.92	\$14.75	\$16.15	\$0.00	\$68.82
	06/01/2025	\$38.77	\$14.75	\$16.15	\$0.00	\$69.67
	12/01/2025	\$39.72	\$14.75	\$16.15	\$0.00	\$70.62
	06/01/2026	\$40.58	\$14.75	\$16.15	\$0.00	\$71.48
	12/01/2026	\$41.53	\$14.75	\$16.15	\$0.00	\$72.43

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
GLAZIER (GLASS PLANK/AIR BARRIER/INTERIOR SYSTEMS) <i>GLAZIERS LOCAL 35 (ZONE 2)</i>	07/01/2023	\$45.01	\$9.65	\$23.70	\$0.00	\$78.36
	01/01/2024	\$45.56	\$9.95	\$23.95	\$0.00	\$79.46
	07/01/2024	\$46.76	\$9.95	\$23.95	\$0.00	\$80.66
	01/01/2025	\$47.96	\$9.95	\$23.95	\$0.00	\$81.86

Apprentice - GLAZIER - Local 35 Zone 2

Effective Date - 07/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$22.51	\$9.65	\$0.00	\$0.00	\$32.16
2	55	\$24.76	\$9.65	\$6.55	\$0.00	\$40.96
3	60	\$27.01	\$9.65	\$7.14	\$0.00	\$43.80
4	65	\$29.26	\$9.65	\$7.74	\$0.00	\$46.65
5	70	\$31.51	\$9.65	\$20.13	\$0.00	\$61.29
6	75	\$33.76	\$9.65	\$20.73	\$0.00	\$64.14
7	80	\$36.01	\$9.65	\$21.32	\$0.00	\$66.98
8	90	\$40.51	\$9.65	\$22.51	\$0.00	\$72.67

Effective Date - 01/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$22.78	\$9.95	\$0.00	\$0.00	\$32.73
2	55	\$25.06	\$9.95	\$6.66	\$0.00	\$41.67
3	60	\$27.34	\$9.95	\$7.26	\$0.00	\$44.55
4	65	\$29.61	\$9.95	\$7.87	\$0.00	\$47.43
5	70	\$31.89	\$9.95	\$20.32	\$0.00	\$62.16
6	75	\$34.17	\$9.95	\$20.93	\$0.00	\$65.05
7	80	\$36.45	\$9.95	\$21.53	\$0.00	\$67.93
8	90	\$41.00	\$9.95	\$22.74	\$0.00	\$73.69

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

HOISTING ENGINEER/CRANES/GRADALLS <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2023	\$54.28	\$14.75	\$16.15	\$0.00	\$85.18
	12/01/2023	\$55.53	\$14.75	\$16.15	\$0.00	\$86.43
	06/01/2024	\$56.83	\$14.75	\$16.15	\$0.00	\$87.73
	12/01/2024	\$58.28	\$14.75	\$16.15	\$0.00	\$89.18
	06/01/2025	\$59.58	\$14.75	\$16.15	\$0.00	\$90.48
	12/01/2025	\$61.03	\$14.75	\$16.15	\$0.00	\$91.93
	06/01/2026	\$62.33	\$14.75	\$16.15	\$0.00	\$93.23
	12/01/2026	\$63.78	\$14.75	\$16.15	\$0.00	\$94.68

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - OPERATING ENGINEERS - Local 4

Effective Date - 06/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	\$29.85	\$14.75	\$0.00	\$0.00	\$44.60
2	60	\$32.57	\$14.75	\$16.15	\$0.00	\$63.47
3	65	\$35.28	\$14.75	\$16.15	\$0.00	\$66.18
4	70	\$38.00	\$14.75	\$16.15	\$0.00	\$68.90
5	75	\$40.71	\$14.75	\$16.15	\$0.00	\$71.61
6	80	\$43.42	\$14.75	\$16.15	\$0.00	\$74.32
7	85	\$46.14	\$14.75	\$16.15	\$0.00	\$77.04
8	90	\$48.85	\$14.75	\$16.15	\$0.00	\$79.75

Effective Date - 12/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	\$30.54	\$14.75	\$0.00	\$0.00	\$45.29
2	60	\$33.32	\$14.75	\$16.15	\$0.00	\$64.22
3	65	\$36.09	\$14.75	\$16.15	\$0.00	\$66.99
4	70	\$38.87	\$14.75	\$16.15	\$0.00	\$69.77
5	75	\$41.65	\$14.75	\$16.15	\$0.00	\$72.55
6	80	\$44.42	\$14.75	\$16.15	\$0.00	\$75.32
7	85	\$47.20	\$14.75	\$16.15	\$0.00	\$78.10
8	90	\$49.98	\$14.75	\$16.15	\$0.00	\$80.88

Notes:

Apprentice to Journeyworker Ratio:1:6

HVAC (DUCTWORK) SHEETMETAL WORKERS LOCAL 17 - A	08/01/2023	\$57.01	\$14.11	\$26.64	\$2.83	\$100.59
	02/01/2024	\$58.71	\$14.11	\$26.64	\$2.83	\$102.29
	08/01/2024	\$60.46	\$14.11	\$26.64	\$2.83	\$104.04
	02/01/2025	\$62.21	\$14.11	\$26.64	\$2.83	\$105.79
	08/01/2025	\$64.06	\$14.11	\$26.64	\$2.83	\$107.64
	02/01/2026	\$66.01	\$14.11	\$26.64	\$2.83	\$109.59

For apprentice rates see "Apprentice- SHEET METAL WORKER"

HVAC (ELECTRICAL CONTROLS) ELECTRICIANS LOCAL 103	03/01/2023	\$59.23	\$13.00	\$21.63	\$0.00	\$93.86
	08/01/2023	\$57.01	\$14.11	\$26.64	\$2.83	\$100.59
	02/01/2024	\$58.71	\$14.11	\$26.64	\$2.83	\$102.29
	08/01/2024	\$60.46	\$14.11	\$26.64	\$2.83	\$104.04
	02/01/2025	\$62.21	\$14.11	\$26.64	\$2.83	\$105.79
	08/01/2025	\$64.06	\$14.11	\$26.64	\$2.83	\$107.64

For apprentice rates see "Apprentice- ELECTRICIAN"

HVAC (TESTING AND BALANCING - AIR) SHEETMETAL WORKERS LOCAL 17 - A	08/01/2023	\$57.01	\$14.11	\$26.64	\$2.83	\$100.59
	02/01/2024	\$58.71	\$14.11	\$26.64	\$2.83	\$102.29
	08/01/2024	\$60.46	\$14.11	\$26.64	\$2.83	\$104.04
	02/01/2025	\$62.21	\$14.11	\$26.64	\$2.83	\$105.79
	08/01/2025	\$64.06	\$14.11	\$26.64	\$2.83	\$107.64
	02/01/2026	\$66.01	\$14.11	\$26.64	\$2.83	\$109.59

For apprentice rates see "Apprentice- SHEET METAL WORKER"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
HVAC (TESTING AND BALANCING -WATER) <i>PIPEFITTERS LOCAL 537</i>	09/01/2023	\$65.18	\$12.50	\$20.80	\$0.00	\$98.48
	03/01/2024	\$66.98	\$12.50	\$20.80	\$0.00	\$100.28
	09/01/2024	\$68.78	\$12.50	\$20.80	\$0.00	\$102.08
	03/01/2025	\$70.58	\$12.50	\$20.80	\$0.00	\$103.88
For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"						
HVAC MECHANIC <i>PIPEFITTERS LOCAL 537</i>	09/01/2023	\$65.18	\$12.25	\$20.80	\$0.00	\$98.23
	03/01/2024	\$66.98	\$12.25	\$20.80	\$0.00	\$100.03
	09/01/2024	\$68.78	\$12.25	\$20.80	\$0.00	\$101.83
	03/01/2025	\$70.58	\$12.25	\$20.80	\$0.00	\$103.63
For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"						
HYDRAULIC DRILLS <i>LABORERS - ZONE 2</i>	06/01/2023	\$38.21	\$9.40	\$16.89	\$0.00	\$64.50
	12/01/2023	\$39.11	\$9.40	\$16.89	\$0.00	\$65.40
For apprentice rates see "Apprentice- LABORER"						
HYDRAULIC DRILLS (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY & HIGHWAY)</i>	06/01/2023	\$38.21	\$9.40	\$16.89	\$0.00	\$64.50
	12/01/2023	\$39.11	\$9.40	\$16.89	\$0.00	\$65.40
	06/01/2024	\$40.44	\$9.40	\$16.89	\$0.00	\$66.73
	12/01/2024	\$41.77	\$9.40	\$16.89	\$0.00	\$68.06
	06/01/2025	\$43.16	\$9.40	\$16.89	\$0.00	\$69.45
	12/01/2025	\$44.54	\$9.40	\$16.89	\$0.00	\$70.83
	06/01/2026	\$45.98	\$9.40	\$16.89	\$0.00	\$72.27
12/01/2026	\$47.42	\$9.40	\$16.89	\$0.00	\$73.71	
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
INSULATOR (PIPES & TANKS) <i>HEAT & FROST INSULATORS LOCAL 6 (BOSTON)</i>	09/01/2022	\$53.85	\$13.80	\$17.14	\$0.00	\$84.79

Apprentice - ASBESTOS INSULATOR (Pipes & Tanks) - Local 6 Boston

Effective Date - 09/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$26.93	\$13.80	\$12.42	\$0.00	\$53.15
2	60	\$32.31	\$13.80	\$13.36	\$0.00	\$59.47
3	70	\$37.70	\$13.80	\$14.31	\$0.00	\$65.81
4	80	\$43.08	\$13.80	\$15.25	\$0.00	\$72.13

Notes:

Steps are 1 year

Apprentice to Journeyworker Ratio:1:4

IRONWORKER/WELDER <i>IRONWORKERS LOCAL 7 (BOSTON AREA)</i>	03/16/2023	\$52.72	\$8.35	\$26.70	\$0.00	\$87.77
	03/16/2024	\$53.97	\$8.35	\$26.70	\$0.00	\$89.02

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - IRONWORKER - Local 7 Boston

Effective Date - 03/16/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$31.63	\$8.35	\$26.70	\$0.00	\$66.68
2	70	\$36.90	\$8.35	\$26.70	\$0.00	\$71.95
3	75	\$39.54	\$8.35	\$26.70	\$0.00	\$74.59
4	80	\$42.18	\$8.35	\$26.70	\$0.00	\$77.23
5	85	\$44.81	\$8.35	\$26.70	\$0.00	\$79.86
6	90	\$47.45	\$8.35	\$26.70	\$0.00	\$82.50

Effective Date - 03/16/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$32.38	\$8.35	\$26.70	\$0.00	\$67.43
2	70	\$37.78	\$8.35	\$26.70	\$0.00	\$72.83
3	75	\$40.48	\$8.35	\$26.70	\$0.00	\$75.53
4	80	\$43.18	\$8.35	\$26.70	\$0.00	\$78.23
5	85	\$45.87	\$8.35	\$26.70	\$0.00	\$80.92
6	90	\$48.57	\$8.35	\$26.70	\$0.00	\$83.62

Notes:

Apprentice to Journeyworker Ratio:1:4

JACKHAMMER & PAVING BREAKER OPERATOR	06/01/2023	\$37.71	\$9.40	\$16.89	\$0.00	\$64.00
LABORERS - ZONE 2	12/01/2023	\$38.61	\$9.40	\$16.89	\$0.00	\$64.90
For apprentice rates see "Apprentice- LABORER"						
LABORER	06/01/2023	\$37.46	\$9.40	\$16.89	\$0.00	\$63.75
LABORERS - ZONE 2	12/01/2023	\$38.36	\$9.40	\$16.89	\$0.00	\$64.65

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - LABORER - Zone 2

Effective Date - 06/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$22.48	\$9.40	\$16.89	\$0.00	\$48.77
2	70	\$26.22	\$9.40	\$16.89	\$0.00	\$52.51
3	80	\$29.97	\$9.40	\$16.89	\$0.00	\$56.26
4	90	\$33.71	\$9.40	\$16.89	\$0.00	\$60.00

Effective Date - 12/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$23.02	\$9.40	\$16.89	\$0.00	\$49.31
2	70	\$26.85	\$9.40	\$16.89	\$0.00	\$53.14
3	80	\$30.69	\$9.40	\$16.89	\$0.00	\$56.98
4	90	\$34.52	\$9.40	\$16.89	\$0.00	\$60.81

Notes:

Apprentice to Journeyworker Ratio:1:5

LABORER (HEAVY & HIGHWAY)	06/01/2023	\$37.46	\$9.40	\$16.89	\$0.00	\$63.75
LABORERS - ZONE 2 (HEAVY & HIGHWAY)	12/01/2023	\$38.36	\$9.40	\$16.89	\$0.00	\$64.65
	06/01/2024	\$39.69	\$9.40	\$16.89	\$0.00	\$65.98
	12/01/2024	\$41.02	\$9.40	\$16.89	\$0.00	\$67.31
	06/01/2025	\$42.41	\$9.40	\$16.89	\$0.00	\$68.70
	12/01/2025	\$43.79	\$9.40	\$16.89	\$0.00	\$70.08
	06/01/2026	\$45.23	\$9.40	\$16.89	\$0.00	\$71.52
	12/01/2026	\$46.67	\$9.40	\$16.89	\$0.00	\$72.96

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - LABORER (Heavy & Highway) - Zone 2

Effective Date - 06/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$22.48	\$9.40	\$16.89	\$0.00	\$48.77
2	70	\$26.22	\$9.40	\$16.89	\$0.00	\$52.51
3	80	\$29.97	\$9.40	\$16.89	\$0.00	\$56.26
4	90	\$33.71	\$9.40	\$16.89	\$0.00	\$60.00

Effective Date - 12/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$23.02	\$9.40	\$16.89	\$0.00	\$49.31
2	70	\$26.85	\$9.40	\$16.89	\$0.00	\$53.14
3	80	\$30.69	\$9.40	\$16.89	\$0.00	\$56.98
4	90	\$34.52	\$9.40	\$16.89	\$0.00	\$60.81

Notes:

Apprentice to Journeyworker Ratio:1:5

LABORER: CARPENTER TENDER LABORERS - ZONE 2	06/01/2023	\$37.46	\$9.40	\$16.89	\$0.00	\$63.75
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For apprentice rates see "Apprentice- LABORER"

	12/01/2023	\$38.36	\$9.40	\$16.89	\$0.00	\$64.65
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LABORER: CEMENT FINISHER TENDER LABORERS - ZONE 2	06/01/2023	\$37.46	\$9.40	\$16.89	\$0.00	\$63.75
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For apprentice rates see "Apprentice- LABORER"

	12/01/2023	\$38.36	\$9.40	\$16.89	\$0.00	\$64.65
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LABORER: HAZARDOUS WASTE/ASBESTOS REMOVER LABORERS - ZONE 2	06/01/2023	\$37.55	\$9.40	\$16.95	\$0.00	\$63.90
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For apprentice rates see "Apprentice- LABORER"

	12/01/2023	\$38.45	\$9.40	\$16.95	\$0.00	\$64.80
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LABORER: MASON TENDER LABORERS - ZONE 2	06/01/2023	\$37.71	\$9.40	\$16.89	\$0.00	\$64.00
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For apprentice rates see "Apprentice- LABORER"

	12/01/2023	\$38.61	\$9.40	\$16.89	\$0.00	\$64.90
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LABORER: MASON TENDER (HEAVY & HIGHWAY) LABORERS - ZONE 2 (HEAVY & HIGHWAY)	06/01/2023	\$37.71	\$9.40	\$16.89	\$0.00	\$64.00
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	12/01/2023	\$38.61	\$9.40	\$16.89	\$0.00	\$64.90
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	06/01/2024	\$39.94	\$9.40	\$16.89	\$0.00	\$66.23
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	12/01/2024	\$41.27	\$9.40	\$16.89	\$0.00	\$67.56
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	06/01/2025	\$42.66	\$9.40	\$16.89	\$0.00	\$68.95
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	12/01/2025	\$44.04	\$9.40	\$16.89	\$0.00	\$70.33
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	06/01/2026	\$45.48	\$9.40	\$16.89	\$0.00	\$71.77
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	12/01/2026	\$46.92	\$9.40	\$16.89	\$0.00	\$73.21
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For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"

LABORER: MULTI-TRADE TENDER LABORERS - ZONE 2	06/01/2023	\$37.46	\$9.40	\$16.89	\$0.00	\$63.75
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For apprentice rates see "Apprentice- LABORER"

	12/01/2023	\$38.36	\$9.40	\$16.89	\$0.00	\$64.65
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LABORER: TREE REMOVER LABORERS - ZONE 2	06/01/2023	\$37.46	\$9.40	\$16.89	\$0.00	\$63.75
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	12/01/2023	\$38.36	\$9.40	\$16.89	\$0.00	\$64.65
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This classification applies to the removal of standing trees, and the trimming and removal of branches and limbs when related to public works construction or site clearance incidental to construction . For apprentice rates see "Apprentice- LABORER"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
LASER BEAM OPERATOR <i>LABORERS - ZONE 2</i>	06/01/2023	\$37.71	\$9.40	\$16.89	\$0.00	\$64.00
	12/01/2023	\$38.61	\$9.40	\$16.89	\$0.00	\$64.90
For apprentice rates see "Apprentice- LABORER"						
LASER BEAM OPERATOR (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY & HIGHWAY)</i>	06/01/2023	\$37.71	\$9.40	\$16.89	\$0.00	\$64.00
	12/01/2023	\$38.61	\$9.40	\$16.89	\$0.00	\$64.90
	06/01/2024	\$39.94	\$9.40	\$16.89	\$0.00	\$66.23
	12/01/2024	\$41.27	\$9.40	\$16.89	\$0.00	\$67.56
	06/01/2025	\$42.66	\$9.40	\$16.89	\$0.00	\$68.95
	12/01/2025	\$44.04	\$9.40	\$16.89	\$0.00	\$70.33
	06/01/2026	\$45.48	\$9.40	\$16.89	\$0.00	\$71.77
	12/01/2026	\$46.92	\$9.40	\$16.89	\$0.00	\$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						

MARBLE & TILE FINISHERS <i>BRICKLAYERS LOCAL 3 - MARBLE & TILE</i>	08/01/2023	\$47.89	\$11.49	\$20.37	\$0.00	\$79.75
	02/01/2024	\$48.89	\$11.49	\$20.37	\$0.00	\$80.75
	08/01/2024	\$50.57	\$11.49	\$20.37	\$0.00	\$82.43
	02/01/2025	\$51.61	\$11.49	\$20.37	\$0.00	\$83.47
	08/01/2025	\$53.33	\$11.49	\$20.37	\$0.00	\$85.19
	02/01/2026	\$54.41	\$11.49	\$20.37	\$0.00	\$86.27
	08/01/2026	\$56.17	\$11.49	\$20.37	\$0.00	\$88.03
	02/01/2027	\$57.29	\$11.49	\$20.37	\$0.00	\$89.15

Apprentice - MARBLE & TILE FINISHER - Local 3 Marble & Tile

Effective Date - 08/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$23.95	\$11.49	\$20.37	\$0.00	\$55.81
2	60	\$28.73	\$11.49	\$20.37	\$0.00	\$60.59
3	70	\$33.52	\$11.49	\$20.37	\$0.00	\$65.38
4	80	\$38.31	\$11.49	\$20.37	\$0.00	\$70.17
5	90	\$43.10	\$11.49	\$20.37	\$0.00	\$74.96

Effective Date - 02/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$24.45	\$11.49	\$20.37	\$0.00	\$56.31
2	60	\$29.33	\$11.49	\$20.37	\$0.00	\$61.19
3	70	\$34.22	\$11.49	\$20.37	\$0.00	\$66.08
4	80	\$39.11	\$11.49	\$20.37	\$0.00	\$70.97
5	90	\$44.00	\$11.49	\$20.37	\$0.00	\$75.86

Notes:

Apprentice to Journeyworker Ratio:1:3

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
MARBLE MASONS, TILELAYERS & TERRAZZO MECH <i>BRICKLAYERS LOCAL 3 - MARBLE & TILE</i>	08/01/2023	\$62.42	\$11.49	\$22.31	\$0.00	\$96.22
	02/01/2024	\$63.67	\$11.49	\$22.31	\$0.00	\$97.47
	08/01/2024	\$65.77	\$11.49	\$22.31	\$0.00	\$99.57
	02/01/2025	\$67.07	\$11.49	\$22.31	\$0.00	\$100.87
	08/01/2025	\$69.22	\$11.49	\$22.31	\$0.00	\$103.02
	02/01/2026	\$70.57	\$11.49	\$22.31	\$0.00	\$104.37
	08/01/2026	\$72.77	\$11.49	\$22.31	\$0.00	\$106.57
	02/01/2027	\$74.17	\$11.49	\$22.31	\$0.00	\$107.97

Apprentice - MARBLE-TILE-TERRAZZO MECHANIC - Local 3 Marble & Tile

Effective Date - 08/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$31.21	\$11.49	\$22.31	\$0.00	\$65.01
2	60	\$37.45	\$11.49	\$22.31	\$0.00	\$71.25
3	70	\$43.69	\$11.49	\$22.31	\$0.00	\$77.49
4	80	\$49.94	\$11.49	\$22.31	\$0.00	\$83.74
5	90	\$56.18	\$11.49	\$22.31	\$0.00	\$89.98

Effective Date - 02/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$31.84	\$11.49	\$22.31	\$0.00	\$65.64
2	60	\$38.20	\$11.49	\$22.31	\$0.00	\$72.00
3	70	\$44.57	\$11.49	\$22.31	\$0.00	\$78.37
4	80	\$50.94	\$11.49	\$22.31	\$0.00	\$84.74
5	90	\$57.30	\$11.49	\$22.31	\$0.00	\$91.10

Notes:

Apprentice to Journeyworker Ratio:1:5

MECH. SWEEPER OPERATOR (ON CONST. SITES) <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2023	\$53.69	\$14.75	\$16.15	\$0.00	\$84.59
	12/01/2023	\$54.93	\$14.75	\$16.15	\$0.00	\$85.83
	06/01/2024	\$56.21	\$14.75	\$16.15	\$0.00	\$87.11
	12/01/2024	\$57.65	\$14.75	\$16.15	\$0.00	\$88.55
	06/01/2025	\$58.93	\$14.75	\$16.15	\$0.00	\$89.83
	12/01/2025	\$60.37	\$14.75	\$16.15	\$0.00	\$91.27
	06/01/2026	\$61.65	\$14.75	\$16.15	\$0.00	\$92.55
	12/01/2026	\$63.09	\$14.75	\$16.15	\$0.00	\$93.99

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
MECHANICS MAINTENANCE <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2023	\$53.69	\$14.75	\$16.15	\$0.00	\$84.59
	12/01/2023	\$54.93	\$14.75	\$16.15	\$0.00	\$85.83
	06/01/2024	\$56.21	\$14.75	\$16.15	\$0.00	\$87.11
	12/01/2024	\$57.65	\$14.75	\$16.15	\$0.00	\$88.55
	06/01/2025	\$58.93	\$14.75	\$16.15	\$0.00	\$89.83
	12/01/2025	\$60.37	\$14.75	\$16.15	\$0.00	\$91.27
	06/01/2026	\$61.65	\$14.75	\$16.15	\$0.00	\$92.55
	12/01/2026	\$63.09	\$14.75	\$16.15	\$0.00	\$93.99

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

MILLWRIGHT (Zone 2) <i>MILLWRIGHTS LOCAL 1121 - Zone 2</i>	01/02/2023	\$41.92	\$8.58	\$21.57	\$0.00	\$72.07
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Apprentice - MILLWRIGHT - Local 1121 Zone 2

Effective Date - 01/02/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	\$23.06	\$8.58	\$5.72	\$0.00	\$37.36
2	65	\$27.25	\$8.58	\$17.93	\$0.00	\$53.76
3	75	\$31.44	\$8.58	\$18.98	\$0.00	\$59.00
4	85	\$35.63	\$8.58	\$20.01	\$0.00	\$64.22

Notes: Step 1&2 Appr. indentured after 1/6/2020 receive no pension, but do receive annuity. (Step 1 \$5.72, Step 2 \$6.66)
Steps are 2,000 hours

Apprentice to Journeyworker Ratio:1:4

MORTAR MIXER <i>LABORERS - ZONE 2</i>	06/01/2023	\$37.71	\$9.40	\$16.89	\$0.00	\$64.00
	12/01/2023	\$38.61	\$9.40	\$16.89	\$0.00	\$64.90

For apprentice rates see "Apprentice- LABORER"

OILER (OTHER THAN TRUCK CRANES,GRADALLS) <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2023	\$24.34	\$14.75	\$16.15	\$0.00	\$55.24
	12/01/2023	\$24.91	\$14.75	\$16.15	\$0.00	\$55.81
	06/01/2024	\$25.51	\$14.75	\$16.15	\$0.00	\$56.41
	12/01/2024	\$26.17	\$14.75	\$16.15	\$0.00	\$57.07
	06/01/2025	\$26.77	\$14.75	\$16.15	\$0.00	\$57.67
	12/01/2025	\$27.43	\$14.75	\$16.15	\$0.00	\$58.33
	06/01/2026	\$28.02	\$14.75	\$16.15	\$0.00	\$58.92
	12/01/2026	\$28.69	\$14.75	\$16.15	\$0.00	\$59.59

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

OILER (TRUCK CRANES, GRADALLS) <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2023	\$29.67	\$14.75	\$16.15	\$0.00	\$60.57
	12/01/2023	\$30.36	\$14.75	\$16.15	\$0.00	\$61.26
	06/01/2024	\$31.08	\$14.75	\$16.15	\$0.00	\$61.98
	12/01/2024	\$31.88	\$14.75	\$16.15	\$0.00	\$62.78
	06/01/2025	\$32.60	\$14.75	\$16.15	\$0.00	\$63.50
	12/01/2025	\$33.40	\$14.75	\$16.15	\$0.00	\$64.30
	06/01/2026	\$34.12	\$14.75	\$16.15	\$0.00	\$65.02
	12/01/2026	\$34.92	\$14.75	\$16.15	\$0.00	\$65.82

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
OTHER POWER DRIVEN EQUIPMENT - CLASS II <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2023	\$53.69	\$14.75	\$16.15	\$0.00	\$84.59
	12/01/2023	\$54.93	\$14.75	\$16.15	\$0.00	\$85.83
	06/01/2024	\$56.21	\$14.75	\$16.15	\$0.00	\$87.11
	12/01/2024	\$57.65	\$14.75	\$16.15	\$0.00	\$88.55
	06/01/2025	\$58.93	\$14.75	\$16.15	\$0.00	\$89.83
	12/01/2025	\$60.37	\$14.75	\$16.15	\$0.00	\$91.27
	06/01/2026	\$61.65	\$14.75	\$16.15	\$0.00	\$92.55
	12/01/2026	\$63.09	\$14.75	\$16.15	\$0.00	\$93.99

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

PAINTER (BRIDGES/TANKS) <i>PAINTERS LOCAL 35 - ZONE 2</i>	07/01/2023	\$55.51	\$9.65	\$23.70	\$0.00	\$88.86
	01/01/2024	\$56.06	\$9.95	\$23.95	\$0.00	\$89.96
	07/01/2024	\$57.26	\$9.95	\$23.95	\$0.00	\$91.16
	01/01/2025	\$58.46	\$9.95	\$23.95	\$0.00	\$92.36

Apprentice - PAINTER Local 35 - BRIDGES/TANKS

Effective Date - 07/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$27.76	\$9.65	\$0.00	\$0.00	\$37.41
2	55	\$30.53	\$9.65	\$6.55	\$0.00	\$46.73
3	60	\$33.31	\$9.65	\$7.14	\$0.00	\$50.10
4	65	\$36.08	\$9.65	\$7.74	\$0.00	\$53.47
5	70	\$38.86	\$9.65	\$20.13	\$0.00	\$68.64
6	75	\$41.63	\$9.65	\$20.73	\$0.00	\$72.01
7	80	\$44.41	\$9.65	\$21.32	\$0.00	\$75.38
8	90	\$49.96	\$9.65	\$22.51	\$0.00	\$82.12

Effective Date - 01/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$28.03	\$9.95	\$0.00	\$0.00	\$37.98
2	55	\$30.83	\$9.95	\$6.66	\$0.00	\$47.44
3	60	\$33.64	\$9.95	\$7.26	\$0.00	\$50.85
4	65	\$36.44	\$9.95	\$7.87	\$0.00	\$54.26
5	70	\$39.24	\$9.95	\$20.32	\$0.00	\$69.51
6	75	\$42.05	\$9.95	\$20.93	\$0.00	\$72.93
7	80	\$44.85	\$9.95	\$21.53	\$0.00	\$76.33
8	90	\$50.45	\$9.95	\$22.74	\$0.00	\$83.14

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER (SPRAY OR SANDBLAST, NEW) * * If 30% or more of surfaces to be painted are new construction, NEW paint rate shall be used. <i>PAINTERS LOCAL 35 - ZONE 2</i>	07/01/2023	\$46.41	\$9.65	\$23.70	\$0.00	\$79.76
	01/01/2024	\$46.96	\$9.95	\$23.95	\$0.00	\$80.86
	07/01/2024	\$48.16	\$9.95	\$23.95	\$0.00	\$82.06
	01/01/2025	\$49.36	\$9.95	\$23.95	\$0.00	\$83.26

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - PAINTER Local 35 Zone 2 - Spray/Sandblast - New

Effective Date - 07/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$23.21	\$9.65	\$0.00	\$0.00	\$32.86
2	55	\$25.53	\$9.65	\$6.55	\$0.00	\$41.73
3	60	\$27.85	\$9.65	\$7.14	\$0.00	\$44.64
4	65	\$30.17	\$9.65	\$7.74	\$0.00	\$47.56
5	70	\$32.49	\$9.65	\$20.13	\$0.00	\$62.27
6	75	\$34.81	\$9.65	\$20.73	\$0.00	\$65.19
7	80	\$37.13	\$9.65	\$21.32	\$0.00	\$68.10
8	90	\$41.77	\$8.65	\$22.51	\$0.00	\$72.93

Effective Date - 01/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$23.48	\$9.95	\$0.00	\$0.00	\$33.43
2	55	\$25.83	\$9.95	\$6.66	\$0.00	\$42.44
3	60	\$28.18	\$9.95	\$7.26	\$0.00	\$45.39
4	65	\$30.52	\$9.95	\$7.87	\$0.00	\$48.34
5	70	\$32.87	\$9.95	\$20.32	\$0.00	\$63.14
6	75	\$35.22	\$9.95	\$20.93	\$0.00	\$66.10
7	80	\$37.57	\$9.95	\$21.53	\$0.00	\$69.05
8	90	\$42.26	\$9.95	\$22.74	\$0.00	\$74.95

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER (SPRAY OR SANDBLAST, REPAINT)	07/01/2023	\$44.47	\$9.65	\$23.70	\$0.00	\$77.82
PAINTERS LOCAL 35 - ZONE 2	01/01/2024	\$45.02	\$9.95	\$23.95	\$0.00	\$78.92
	07/01/2024	\$46.22	\$9.95	\$23.95	\$0.00	\$80.12
	01/01/2025	\$47.42	\$9.95	\$23.95	\$0.00	\$81.32

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - PAINTER Local 35 Zone 2 - Spray/Sandblast - Repaint

Effective Date - 07/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$22.24	\$9.65	\$0.00	\$0.00	\$31.89
2	55	\$24.46	\$9.65	\$6.55	\$0.00	\$40.66
3	60	\$26.68	\$9.65	\$7.14	\$0.00	\$43.47
4	65	\$28.91	\$9.65	\$7.74	\$0.00	\$46.30
5	70	\$31.13	\$9.65	\$20.13	\$0.00	\$60.91
6	75	\$33.35	\$9.65	\$20.73	\$0.00	\$63.73
7	80	\$35.58	\$9.65	\$21.32	\$0.00	\$66.55
8	90	\$40.02	\$9.65	\$22.51	\$0.00	\$72.18

Effective Date - 01/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$22.51	\$9.95	\$0.00	\$0.00	\$32.46
2	55	\$24.76	\$9.95	\$6.66	\$0.00	\$41.37
3	60	\$27.01	\$9.95	\$7.26	\$0.00	\$44.22
4	65	\$29.26	\$9.95	\$7.87	\$0.00	\$47.08
5	70	\$31.51	\$9.95	\$20.32	\$0.00	\$61.78
6	75	\$33.77	\$9.95	\$20.93	\$0.00	\$64.65
7	80	\$36.02	\$9.95	\$21.53	\$0.00	\$67.50
8	90	\$40.52	\$9.95	\$22.74	\$0.00	\$73.21

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER / TAPER (BRUSH, NEW) *	07/01/2023	\$45.01	\$9.65	\$23.70	\$0.00	\$78.36
* If 30% or more of surfaces to be painted are new construction, NEW paint rate shall be used. PAINTERS LOCAL 35 - ZONE 2	01/01/2024	\$45.56	\$9.95	\$23.95	\$0.00	\$79.46
	07/01/2024	\$46.76	\$9.95	\$23.95	\$0.00	\$80.66
	01/01/2025	\$47.96	\$9.95	\$23.95	\$0.00	\$81.86

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - PAINTER - Local 35 Zone 2 - BRUSH NEW

Effective Date - 07/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$22.51	\$9.65	\$0.00	\$0.00	\$32.16
2	55	\$24.76	\$9.65	\$6.55	\$0.00	\$40.96
3	60	\$27.01	\$9.65	\$7.14	\$0.00	\$43.80
4	65	\$29.26	\$9.65	\$7.74	\$0.00	\$46.65
5	70	\$31.51	\$9.65	\$20.13	\$0.00	\$61.29
6	75	\$33.76	\$9.65	\$20.73	\$0.00	\$64.14
7	80	\$36.01	\$9.65	\$21.32	\$0.00	\$66.98
8	90	\$40.51	\$9.65	\$22.51	\$0.00	\$72.67

Effective Date - 01/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$22.78	\$9.95	\$0.00	\$0.00	\$32.73
2	55	\$25.06	\$9.95	\$6.66	\$0.00	\$41.67
3	60	\$27.34	\$9.95	\$7.26	\$0.00	\$44.55
4	65	\$29.61	\$9.95	\$7.87	\$0.00	\$47.43
5	70	\$31.89	\$9.95	\$20.32	\$0.00	\$62.16
6	75	\$34.17	\$9.95	\$20.93	\$0.00	\$65.05
7	80	\$36.45	\$9.95	\$21.53	\$0.00	\$67.93
8	90	\$41.00	\$9.95	\$22.74	\$0.00	\$73.69

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER / TAPER (BRUSH, REPAINT)	07/01/2023	\$43.07	\$9.65	\$23.70	\$0.00	\$76.42
PAINTERS LOCAL 35 - ZONE 2	01/01/2024	\$43.62	\$9.95	\$23.95	\$0.00	\$77.52
	07/01/2024	\$44.82	\$9.95	\$23.95	\$0.00	\$78.72
	01/01/2025	\$46.02	\$9.95	\$23.95	\$0.00	\$79.92

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - PAINTER Local 35 Zone 2 - BRUSH REPAINT

Effective Date - 07/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$21.54	\$9.65	\$0.00	\$0.00	\$31.19
2	55	\$23.69	\$9.65	\$6.27	\$0.00	\$39.61
3	60	\$25.84	\$9.65	\$6.84	\$0.00	\$42.33
4	65	\$28.00	\$9.65	\$7.41	\$0.00	\$45.06
5	70	\$30.15	\$9.65	\$19.78	\$0.00	\$59.58
6	75	\$32.30	\$9.65	\$20.35	\$0.00	\$62.30
7	80	\$34.46	\$9.65	\$20.92	\$0.00	\$65.03
8	90	\$38.76	\$9.65	\$22.06	\$0.00	\$70.47

Effective Date - 01/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$21.81	\$9.95	\$0.00	\$0.00	\$31.76
2	55	\$23.99	\$9.95	\$6.66	\$0.00	\$40.60
3	60	\$26.17	\$9.95	\$7.26	\$0.00	\$43.38
4	65	\$28.35	\$9.95	\$7.87	\$0.00	\$46.17
5	70	\$30.53	\$9.95	\$20.32	\$0.00	\$60.80
6	75	\$32.72	\$9.95	\$20.93	\$0.00	\$63.60
7	80	\$34.90	\$9.95	\$21.53	\$0.00	\$66.38
8	90	\$39.26	\$9.95	\$22.74	\$0.00	\$71.95

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER TRAFFIC MARKINGS (HEAVY/HIGHWAY)	06/01/2023	\$37.46	\$9.40	\$16.89	\$0.00	\$63.75
LABORERS - ZONE 2 (HEAVY & HIGHWAY)	12/01/2023	\$38.36	\$9.40	\$16.89	\$0.00	\$64.65
	06/01/2024	\$39.69	\$9.40	\$16.89	\$0.00	\$65.98
	12/01/2024	\$41.02	\$9.40	\$16.89	\$0.00	\$67.31
	06/01/2025	\$42.41	\$9.40	\$16.89	\$0.00	\$68.70
	12/01/2025	\$43.79	\$9.40	\$16.89	\$0.00	\$70.08
	06/01/2026	\$45.23	\$9.40	\$16.89	\$0.00	\$71.52
	12/01/2026	\$46.67	\$9.40	\$16.89	\$0.00	\$72.96

For apprentice rates see "Apprentice- LABORER (Heavy and Highway)

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
PANEL & PICKUP TRUCKS DRIVER <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2023	\$38.78	\$14.57	\$17.29	\$0.00	\$70.64
	12/01/2023	\$38.78	\$14.57	\$18.67	\$0.00	\$72.02
	01/01/2024	\$38.78	\$15.07	\$18.67	\$0.00	\$72.52
	06/01/2024	\$39.78	\$15.07	\$18.67	\$0.00	\$73.52
	12/01/2024	\$39.78	\$15.07	\$20.17	\$0.00	\$75.02
	01/01/2025	\$39.78	\$15.57	\$20.17	\$0.00	\$75.52
	06/01/2025	\$40.78	\$15.57	\$20.17	\$0.00	\$76.52
	12/01/2025	\$40.78	\$15.57	\$21.78	\$0.00	\$78.13
	01/01/2026	\$40.78	\$16.17	\$21.78	\$0.00	\$78.73
	06/01/2026	\$41.78	\$16.17	\$21.78	\$0.00	\$79.73
	12/01/2026	\$41.78	\$16.17	\$23.52	\$0.00	\$81.47
	01/01/2027	\$41.78	\$16.77	\$23.52	\$0.00	\$82.07
PIER AND DOCK CONSTRUCTOR (UNDERPINNING AND DECK) <i>PILE DRIVER LOCAL 56 (ZONE 1)</i> For apprentice rates see "Apprentice- PILE DRIVER"	08/01/2020	\$49.07	\$9.40	\$23.12	\$0.00	\$81.59
PILE DRIVER <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$49.07	\$9.40	\$23.12	\$0.00	\$81.59

Apprentice - PILE DRIVER - Local 56 Zone 1

Effective Date - 08/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$24.54	\$9.40	\$23.12	\$0.00	\$57.06
2	60	\$29.44	\$9.40	\$23.12	\$0.00	\$61.96
3	70	\$34.35	\$9.40	\$23.12	\$0.00	\$66.87
4	75	\$36.80	\$9.40	\$23.12	\$0.00	\$69.32
5	80	\$39.26	\$9.40	\$23.12	\$0.00	\$71.78
6	80	\$39.26	\$9.40	\$23.12	\$0.00	\$71.78
7	90	\$44.16	\$9.40	\$23.12	\$0.00	\$76.68
8	90	\$44.16	\$9.40	\$23.12	\$0.00	\$76.68

Notes:

% Indentured After 10/1/17; 45/45/55/55/70/70/80/80
Step 1&2 \$34.01/ 3&4 \$41.46/ 5&6 \$62.80/ 7&8 \$69.25

Apprentice to Journeyworker Ratio:1:5

PIPEFITTER & STEAMFITTER <i>PIPEFITTERS LOCAL 537</i>	09/01/2023	\$65.18	\$12.25	\$20.80	\$0.00	\$98.23
	03/01/2024	\$66.98	\$12.25	\$20.80	\$0.00	\$100.03
	09/01/2024	\$68.78	\$12.25	\$20.80	\$0.00	\$101.83
	03/01/2025	\$70.58	\$12.25	\$20.80	\$0.00	\$103.63

Apprentice - PIPEFITTER - Local 537

Effective Date - 09/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$26.07	\$12.25	\$8.55	\$0.00	\$46.87
2	45	\$29.33	\$12.25	\$20.80	\$0.00	\$62.38
3	60	\$39.11	\$12.25	\$20.80	\$0.00	\$72.16
4	70	\$45.63	\$12.25	\$20.80	\$0.00	\$78.68
5	80	\$52.14	\$12.25	\$20.80	\$0.00	\$85.19

Effective Date - 03/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$26.79	\$12.25	\$8.55	\$0.00	\$47.59
2	45	\$30.14	\$12.25	\$20.80	\$0.00	\$63.19
3	60	\$40.19	\$12.25	\$20.80	\$0.00	\$73.24
4	70	\$46.89	\$12.25	\$20.80	\$0.00	\$79.94
5	80	\$53.58	\$12.25	\$20.80	\$0.00	\$86.63

Notes:

** 1:3; 3:15; 1:10 thereafter / Steps are 1 yr.
 Refrig/AC Mechanic **1:1;1:2;2:4;3:6;4:8;5:10;6:12;7:14;8:17;9:20;10:23(Max)

Apprentice to Journeyworker Ratio:**

PIPELAYER	06/01/2023	\$37.71	\$9.40	\$16.89	\$0.00	\$64.00
LABORERS - ZONE 2	12/01/2023	\$38.61	\$9.40	\$16.89	\$0.00	\$64.90

For apprentice rates see "Apprentice- LABORER"

PIPELAYER (HEAVY & HIGHWAY)	06/01/2023	\$37.71	\$9.40	\$16.89	\$0.00	\$64.00
LABORERS - ZONE 2 (HEAVY & HIGHWAY)	12/01/2023	\$38.61	\$9.40	\$16.89	\$0.00	\$64.90
	06/01/2024	\$39.94	\$9.40	\$16.89	\$0.00	\$66.23
	12/01/2024	\$41.27	\$9.40	\$16.89	\$0.00	\$67.56
	06/01/2025	\$42.66	\$9.40	\$16.89	\$0.00	\$68.95
	12/01/2025	\$44.04	\$9.40	\$16.89	\$0.00	\$70.33
	06/01/2026	\$45.48	\$9.40	\$16.89	\$0.00	\$71.77
	12/01/2026	\$46.92	\$9.40	\$16.89	\$0.00	\$73.21

For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"

PLUMBERS & GASFITTERS	09/03/2023	\$66.44	\$14.07	\$18.86	\$0.00	\$99.37
PLUMBERS & GASFITTERS LOCAL 12	03/03/2024	\$68.24	\$14.07	\$18.86	\$0.00	\$101.17
	09/01/2024	\$70.04	\$14.07	\$18.86	\$0.00	\$102.97
	03/02/2025	\$71.34	\$14.32	\$19.11	\$0.00	\$104.77

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - PLUMBER/GASFITTER - Local 12

Effective Date - 09/03/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$23.25	\$14.07	\$6.80	\$0.00	\$44.12
2	40	\$26.58	\$14.07	\$7.72	\$0.00	\$48.37
3	55	\$36.54	\$14.07	\$10.51	\$0.00	\$61.12
4	65	\$43.19	\$14.07	\$12.36	\$0.00	\$69.62
5	75	\$49.83	\$14.07	\$14.22	\$0.00	\$78.12

Effective Date - 03/03/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$23.88	\$14.07	\$6.80	\$0.00	\$44.75
2	40	\$27.30	\$14.07	\$7.72	\$0.00	\$49.09
3	55	\$37.53	\$14.07	\$10.51	\$0.00	\$62.11
4	65	\$44.36	\$14.07	\$12.36	\$0.00	\$70.79
5	75	\$51.18	\$14.07	\$14.22	\$0.00	\$79.47

Notes:

** 1:2; 2:6; 3:10; 4:14; 5:19/Steps are 1 yr
Step4 with lic\$69.00, Step5 with lic\$76.87

Apprentice to Journeyworker Ratio:**

PNEUMATIC CONTROLS (TEMP.)	09/01/2023	\$65.18	\$12.00	\$20.80	\$0.00	\$97.98
PIPEFITTERS LOCAL 537	03/01/2024	\$66.98	\$12.00	\$20.80	\$0.00	\$99.78
	09/01/2024	\$68.78	\$12.00	\$20.80	\$0.00	\$101.58
	03/01/2025	\$70.58	\$12.00	\$20.80	\$0.00	\$103.38

For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"

PNEUMATIC DRILL/TOOL OPERATOR	06/01/2023	\$37.71	\$9.40	\$16.89	\$0.00	\$64.00
LABORERS - ZONE 2	12/01/2023	\$38.61	\$9.40	\$16.89	\$0.00	\$64.90

For apprentice rates see "Apprentice- LABORER"

PNEUMATIC DRILL/TOOL OPERATOR (HEAVY & HIGHWAY)	06/01/2023	\$37.71	\$9.40	\$16.89	\$0.00	\$64.00
LABORERS - ZONE 2 (HEAVY & HIGHWAY)	12/01/2023	\$38.61	\$9.40	\$16.89	\$0.00	\$64.90
	06/01/2024	\$39.94	\$9.40	\$16.89	\$0.00	\$66.23
	12/01/2024	\$41.27	\$9.40	\$16.89	\$0.00	\$67.56
	06/01/2025	\$42.66	\$9.40	\$16.89	\$0.00	\$68.95
	12/01/2025	\$44.04	\$9.40	\$16.89	\$0.00	\$70.33
	06/01/2026	\$45.48	\$9.40	\$16.89	\$0.00	\$71.77
	12/01/2026	\$46.92	\$9.40	\$16.89	\$0.00	\$73.21

For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"

POWDERMAN & BLASTER	06/01/2023	\$38.46	\$9.40	\$16.89	\$0.00	\$64.75
LABORERS - ZONE 2	12/01/2023	\$39.36	\$9.40	\$16.89	\$0.00	\$65.65

For apprentice rates see "Apprentice- LABORER"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
POWDERMAN & BLASTER (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY & HIGHWAY)</i>	06/01/2023	\$38.46	\$9.40	\$16.89	\$0.00	\$64.75
	12/01/2023	\$39.36	\$9.40	\$16.89	\$0.00	\$65.65
	06/01/2024	\$40.69	\$9.40	\$16.89	\$0.00	\$66.98
	12/01/2024	\$42.02	\$9.40	\$16.89	\$0.00	\$68.31
	06/01/2025	\$43.41	\$9.40	\$16.89	\$0.00	\$69.70
	12/01/2025	\$44.79	\$9.40	\$16.89	\$0.00	\$71.08
	06/01/2026	\$46.23	\$9.40	\$16.89	\$0.00	\$72.52
	12/01/2026	\$47.67	\$9.40	\$16.89	\$0.00	\$73.96
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)						
POWER SHOVEL/DERRICK/TRENCHING MACHINE <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2023	\$54.28	\$14.75	\$16.15	\$0.00	\$85.18
	12/01/2023	\$55.53	\$14.75	\$16.15	\$0.00	\$86.43
	06/01/2024	\$56.83	\$14.75	\$16.15	\$0.00	\$87.73
	12/01/2024	\$58.28	\$14.75	\$16.15	\$0.00	\$89.18
	06/01/2025	\$59.58	\$14.75	\$16.15	\$0.00	\$90.48
	12/01/2025	\$61.03	\$14.75	\$16.15	\$0.00	\$91.93
	06/01/2026	\$62.33	\$14.75	\$16.15	\$0.00	\$93.23
	12/01/2026	\$63.78	\$14.75	\$16.15	\$0.00	\$94.68
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
PUMP OPERATOR (CONCRETE) <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2023	\$54.28	\$14.75	\$16.15	\$0.00	\$85.18
	12/01/2023	\$55.53	\$14.75	\$16.15	\$0.00	\$86.43
	06/01/2024	\$56.83	\$14.75	\$16.15	\$0.00	\$87.73
	12/01/2024	\$58.28	\$14.75	\$16.15	\$0.00	\$89.18
	06/01/2025	\$59.58	\$14.75	\$16.15	\$0.00	\$90.48
	12/01/2025	\$61.03	\$14.75	\$16.15	\$0.00	\$91.93
	06/01/2026	\$62.33	\$14.75	\$16.15	\$0.00	\$93.23
	12/01/2026	\$63.78	\$14.75	\$16.15	\$0.00	\$94.68
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
PUMP OPERATOR (DEWATERING, OTHER) <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2023	\$35.30	\$14.75	\$16.15	\$0.00	\$66.20
	12/01/2023	\$36.12	\$14.75	\$16.15	\$0.00	\$67.02
	06/01/2024	\$36.97	\$14.75	\$16.15	\$0.00	\$67.87
	12/01/2024	\$37.92	\$14.75	\$16.15	\$0.00	\$68.82
	06/01/2025	\$38.77	\$14.75	\$16.15	\$0.00	\$69.67
	12/01/2025	\$39.72	\$14.75	\$16.15	\$0.00	\$70.62
	06/01/2026	\$40.58	\$14.75	\$16.15	\$0.00	\$71.48
	12/01/2026	\$41.53	\$14.75	\$16.15	\$0.00	\$72.43
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
READY-MIX CONCRETE DRIVER <i>TEAMSTERS 170 - Dauphinis (Bellingham)</i>	01/01/2023	\$26.40	\$10.26	\$4.75	\$0.00	\$41.41
	12/01/2023	\$27.00	\$10.76	\$5.45	\$0.00	\$43.21
	01/01/2024	\$27.00	\$10.76	\$5.45	\$0.00	\$43.21
	12/01/2024	\$27.60	\$11.26	\$6.15	\$0.00	\$45.01
	01/01/2025	\$27.60	\$11.26	\$6.15	\$0.00	\$45.01

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
RECLAIMERS <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2023	\$53.69	\$14.75	\$16.15	\$0.00	\$84.59
	12/01/2023	\$54.93	\$14.75	\$16.15	\$0.00	\$85.83
	06/01/2024	\$56.21	\$14.75	\$16.15	\$0.00	\$87.11
	12/01/2024	\$57.65	\$14.75	\$16.15	\$0.00	\$88.55
	06/01/2025	\$58.93	\$14.75	\$16.15	\$0.00	\$89.83
	12/01/2025	\$60.37	\$14.75	\$16.15	\$0.00	\$91.27
	06/01/2026	\$61.65	\$14.75	\$16.15	\$0.00	\$92.55
	12/01/2026	\$63.09	\$14.75	\$16.15	\$0.00	\$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
RIDE-ON MOTORIZED BUGGY OPERATOR <i>LABORERS - ZONE 2</i>	06/01/2023	\$37.71	\$9.40	\$16.89	\$0.00	\$64.00
	12/01/2023	\$38.61	\$9.40	\$16.89	\$0.00	\$64.90
For apprentice rates see "Apprentice- LABORER"						
ROLLER/SPREADER/MULCHING MACHINE <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2023	\$53.69	\$14.75	\$16.15	\$0.00	\$84.59
	12/01/2023	\$54.93	\$14.75	\$16.15	\$0.00	\$85.83
	06/01/2024	\$56.21	\$14.75	\$16.15	\$0.00	\$87.11
	12/01/2024	\$57.65	\$14.75	\$16.15	\$0.00	\$88.55
	06/01/2025	\$58.93	\$14.75	\$16.15	\$0.00	\$89.83
	12/01/2025	\$60.37	\$14.75	\$16.15	\$0.00	\$91.27
	06/01/2026	\$61.65	\$14.75	\$16.15	\$0.00	\$92.55
	12/01/2026	\$63.09	\$14.75	\$16.15	\$0.00	\$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
ROOFER (Inc.Roofer Waterproofing &Roofer Damproofg) <i>ROOFERS LOCAL 33</i>	08/01/2023	\$50.03	\$12.78	\$20.20	\$0.00	\$83.01
	02/01/2024	\$51.28	\$12.78	\$20.20	\$0.00	\$84.26
	08/01/2024	\$52.78	\$12.78	\$20.20	\$0.00	\$85.76
	02/01/2025	\$54.03	\$12.78	\$20.20	\$0.00	\$87.01
	08/01/2025	\$55.53	\$12.78	\$20.20	\$0.00	\$88.51
	02/01/2026	\$56.78	\$12.78	\$20.20	\$0.00	\$89.76

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - ROOFER - Local 33

Effective Date - 08/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$25.02	\$12.78	\$5.59	\$0.00	\$43.39
2	60	\$30.02	\$12.78	\$20.20	\$0.00	\$63.00
3	65	\$32.52	\$12.78	\$20.20	\$0.00	\$65.50
4	75	\$37.52	\$12.78	\$20.20	\$0.00	\$70.50
5	85	\$42.53	\$12.78	\$20.20	\$0.00	\$75.51

Effective Date - 02/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$25.64	\$12.78	\$5.59	\$0.00	\$44.01
2	60	\$30.77	\$12.78	\$20.20	\$0.00	\$63.75
3	65	\$33.33	\$12.78	\$20.20	\$0.00	\$66.31
4	75	\$38.46	\$12.78	\$20.20	\$0.00	\$71.44
5	85	\$43.59	\$12.78	\$20.20	\$0.00	\$76.57

Notes: ** 1:5, 2:6-10, the 1:10; Reroofing: 1:4, then 1:1
 Step 1 is 2000 hrs.; Steps 2-5 are 1000 hrs.
 (Hot Pitch Mechanics' receive \$1.00 hr. above ROOFER)

Apprentice to Journeyworker Ratio:**

ROOFER SLATE / TILE / PRECAST CONCRETE	08/01/2023	\$50.28	\$12.78	\$20.20	\$0.00	\$83.26
ROOFERS LOCAL 33	02/01/2024	\$51.53	\$12.78	\$20.20	\$0.00	\$84.51
	08/01/2024	\$53.03	\$12.78	\$20.20	\$0.00	\$86.01
	02/01/2025	\$54.28	\$12.78	\$20.20	\$0.00	\$87.26
	08/01/2025	\$55.78	\$12.78	\$20.20	\$0.00	\$88.76
	02/01/2026	\$57.03	\$12.78	\$20.20	\$0.00	\$90.01

For apprentice rates see "Apprentice- ROOFER"

SHEETMETAL WORKER	08/01/2023	\$57.01	\$14.11	\$26.64	\$2.83	\$100.59
SHEETMETAL WORKERS LOCAL 17 - A	02/01/2024	\$58.71	\$14.11	\$26.64	\$2.83	\$102.29
	08/01/2024	\$60.46	\$14.11	\$26.64	\$2.83	\$104.04
	02/01/2025	\$62.21	\$14.11	\$26.64	\$2.83	\$105.79
	08/01/2025	\$64.06	\$14.11	\$26.64	\$2.83	\$107.64
	02/01/2026	\$66.01	\$14.11	\$26.64	\$2.83	\$109.59

Apprentice - SHEET METAL WORKER - Local 17-A

Effective Date - 08/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	42	\$23.94	\$14.11	\$6.13	\$0.00	\$44.18
2	42	\$23.94	\$14.11	\$6.13	\$0.00	\$44.18
3	47	\$26.79	\$14.11	\$11.90	\$1.58	\$54.38
4	47	\$26.79	\$14.11	\$11.90	\$1.58	\$54.38
5	52	\$29.65	\$14.11	\$12.88	\$1.70	\$58.34
6	52	\$29.65	\$14.11	\$13.13	\$1.70	\$58.59
7	60	\$34.21	\$14.11	\$14.54	\$1.89	\$64.75
8	65	\$37.06	\$14.11	\$15.52	\$2.00	\$68.69
9	75	\$42.76	\$14.11	\$17.48	\$2.23	\$76.58
10	85	\$48.46	\$14.11	\$18.94	\$2.45	\$83.96

Effective Date - 02/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	42	\$24.66	\$14.11	\$6.13	\$0.00	\$44.90
2	42	\$24.66	\$14.11	\$6.13	\$0.00	\$44.90
3	47	\$27.59	\$14.11	\$11.90	\$1.61	\$55.21
4	47	\$27.59	\$14.11	\$11.90	\$1.61	\$55.21
5	52	\$30.53	\$14.11	\$12.88	\$1.73	\$59.25
6	52	\$30.53	\$14.11	\$13.13	\$1.73	\$59.50
7	60	\$35.23	\$14.11	\$14.54	\$1.92	\$65.80
8	65	\$38.16	\$14.11	\$15.52	\$2.03	\$69.82
9	75	\$44.03	\$14.11	\$17.48	\$2.27	\$77.89
10	85	\$49.90	\$14.11	\$18.94	\$2.49	\$85.44

Notes:
Steps are 6 mos.

Apprentice to Journeyworker Ratio:1:4

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
SPECIALIZED EARTH MOVING EQUIP < 35 TONS TEAMSTERS JOINT COUNCIL NO. 10 ZONE B	06/01/2023	\$39.24	\$14.57	\$17.29	\$0.00	\$71.10
	12/01/2023	\$39.24	\$14.57	\$18.67	\$0.00	\$72.48
	01/01/2024	\$39.24	\$15.07	\$18.67	\$0.00	\$72.98
	06/01/2024	\$40.24	\$15.07	\$18.67	\$0.00	\$73.98
	12/01/2024	\$40.24	\$15.07	\$20.17	\$0.00	\$75.48
	01/01/2025	\$40.24	\$15.57	\$20.17	\$0.00	\$75.98
	06/01/2025	\$41.24	\$15.57	\$20.17	\$0.00	\$76.98
	12/01/2025	\$41.24	\$15.57	\$21.78	\$0.00	\$78.59
	01/01/2026	\$41.24	\$16.17	\$21.78	\$0.00	\$79.19
	06/01/2026	\$42.24	\$16.17	\$21.78	\$0.00	\$80.19
	12/01/2026	\$42.24	\$16.17	\$23.52	\$0.00	\$81.93
	01/01/2027	\$42.24	\$16.77	\$23.52	\$0.00	\$82.53

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
SPECIALIZED EARTH MOVING EQUIP > 35 TONS <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2023	\$39.53	\$14.57	\$17.29	\$0.00	\$71.39
	12/01/2023	\$39.53	\$14.57	\$18.67	\$0.00	\$72.77
	01/01/2024	\$39.53	\$15.07	\$18.67	\$0.00	\$73.27
	06/01/2024	\$40.53	\$15.07	\$18.67	\$0.00	\$74.27
	12/01/2024	\$40.53	\$15.07	\$20.17	\$0.00	\$75.77
	01/01/2025	\$40.53	\$15.57	\$20.17	\$0.00	\$76.27
	06/01/2025	\$41.53	\$15.57	\$20.17	\$0.00	\$77.27
	12/01/2025	\$41.53	\$15.57	\$21.78	\$0.00	\$78.88
	01/01/2026	\$41.53	\$16.17	\$21.78	\$0.00	\$79.48
	06/01/2026	\$42.53	\$16.17	\$21.78	\$0.00	\$80.48
	12/01/2026	\$42.53	\$16.17	\$23.52	\$0.00	\$82.22
	01/01/2027	\$42.53	\$16.77	\$23.52	\$0.00	\$82.82
SPRINKLER FITTER <i>SPRINKLER FITTERS LOCAL 550 - (Section A) Zone 1</i>	03/01/2023	\$66.20	\$10.90	\$23.20	\$0.00	\$100.30
	10/01/2023	\$67.95	\$10.90	\$23.20	\$0.00	\$102.05
	03/01/2024	\$69.75	\$10.90	\$23.20	\$0.00	\$103.85
	10/01/2024	\$71.55	\$10.90	\$23.20	\$0.00	\$105.65
	03/01/2025	\$73.35	\$10.90	\$23.20	\$0.00	\$107.45

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - SPRINKLER FITTER - Local 550 (Section A) Zone 1

Effective Date - 03/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$23.17	\$10.90	\$12.80	\$0.00	\$46.87
2	40	\$26.48	\$10.90	\$13.60	\$0.00	\$50.98
3	45	\$29.79	\$10.90	\$14.40	\$0.00	\$55.09
4	50	\$33.10	\$10.90	\$15.20	\$0.00	\$59.20
5	55	\$36.41	\$10.90	\$16.00	\$0.00	\$63.31
6	60	\$39.72	\$10.90	\$16.80	\$0.00	\$67.42
7	65	\$43.03	\$10.90	\$17.60	\$0.00	\$71.53
8	70	\$46.34	\$10.90	\$18.40	\$0.00	\$75.64
9	75	\$49.65	\$10.90	\$19.20	\$0.00	\$79.75
10	80	\$52.96	\$10.90	\$20.00	\$0.00	\$83.86

Effective Date - 10/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$23.78	\$10.90	\$12.80	\$0.00	\$47.48
2	40	\$27.18	\$10.90	\$13.60	\$0.00	\$51.68
3	45	\$30.58	\$10.90	\$14.40	\$0.00	\$55.88
4	50	\$33.98	\$10.90	\$15.20	\$0.00	\$60.08
5	55	\$37.37	\$10.90	\$16.00	\$0.00	\$64.27
6	60	\$40.77	\$10.90	\$16.80	\$0.00	\$68.47
7	65	\$44.17	\$10.90	\$17.60	\$0.00	\$72.67
8	70	\$47.57	\$10.90	\$18.40	\$0.00	\$76.87
9	75	\$50.96	\$10.90	\$19.20	\$0.00	\$81.06
10	80	\$54.36	\$10.90	\$20.00	\$0.00	\$85.26

Notes: Apprentice entered prior 9/30/10:
40/45/50/55/60/65/70/75/80/85
Steps are 850 hours

Apprentice to Journeyworker Ratio:1:3

STEAM BOILER OPERATOR OPERATING ENGINEERS LOCAL 4	06/01/2023	\$53.69	\$14.75	\$16.15	\$0.00	\$84.59
	12/01/2023	\$54.93	\$14.75	\$16.15	\$0.00	\$85.83
	06/01/2024	\$56.21	\$14.75	\$16.15	\$0.00	\$87.11
	12/01/2024	\$57.65	\$14.75	\$16.15	\$0.00	\$88.55
	06/01/2025	\$58.93	\$14.75	\$16.15	\$0.00	\$89.83
	12/01/2025	\$60.37	\$14.75	\$16.15	\$0.00	\$91.27
	06/01/2026	\$61.65	\$14.75	\$16.15	\$0.00	\$92.55
	12/01/2026	\$63.09	\$14.75	\$16.15	\$0.00	\$93.99

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
TAMPERS, SELF-PROPELLED OR TRACTOR DRAWN <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2023	\$53.69	\$14.75	\$16.15	\$0.00	\$84.59
	12/01/2023	\$54.93	\$14.75	\$16.15	\$0.00	\$85.83
	06/01/2024	\$56.21	\$14.75	\$16.15	\$0.00	\$87.11
	12/01/2024	\$57.65	\$14.75	\$16.15	\$0.00	\$88.55
	06/01/2025	\$58.93	\$14.75	\$16.15	\$0.00	\$89.83
	12/01/2025	\$60.37	\$14.75	\$16.15	\$0.00	\$91.27
	06/01/2026	\$61.65	\$14.75	\$16.15	\$0.00	\$92.55
	12/01/2026	\$63.09	\$14.75	\$16.15	\$0.00	\$93.99

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

TELECOMMUNICATION TECHNICIAN <i>ELECTRICIANS LOCAL 103</i>	03/01/2023	\$47.38	\$13.00	\$19.63	\$0.00	\$80.01
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Apprentice - TELECOMMUNICATION TECHNICIAN - Local 103

Effective Date - 03/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	\$21.32	\$13.00	\$0.65	\$0.00	\$34.97
2	45	\$21.32	\$13.00	\$0.65	\$0.00	\$34.97
3	50	\$23.69	\$13.00	\$15.20	\$0.00	\$51.89
4	50	\$23.69	\$13.00	\$15.20	\$0.00	\$51.89
5	55	\$26.06	\$13.00	\$15.58	\$0.00	\$54.64
6	60	\$28.43	\$13.00	\$15.96	\$0.00	\$57.39
7	65	\$30.80	\$13.00	\$16.34	\$0.00	\$60.14
8	70	\$33.17	\$13.00	\$16.73	\$0.00	\$62.90
9	75	\$35.54	\$13.00	\$17.11	\$0.00	\$65.65
10	80	\$37.90	\$13.00	\$17.48	\$0.00	\$68.38

Notes:

Apprentice to Journeyworker Ratio:1:1

TERRAZZO FINISHERS <i>BRICKLAYERS LOCAL 3 - MARBLE & TILE</i>	08/01/2023	\$61.34	\$11.49	\$22.34	\$0.00	\$95.17
	02/01/2024	\$62.59	\$11.49	\$22.34	\$0.00	\$96.42
	08/01/2024	\$64.69	\$11.49	\$22.34	\$0.00	\$98.52
	02/01/2025	\$65.99	\$11.49	\$22.34	\$0.00	\$99.82
	08/01/2025	\$68.14	\$11.49	\$22.34	\$0.00	\$101.97
	02/01/2026	\$69.49	\$11.49	\$22.34	\$0.00	\$103.32
	08/01/2026	\$71.69	\$11.49	\$22.34	\$0.00	\$105.52
	02/01/2027	\$73.09	\$11.49	\$22.34	\$0.00	\$106.92

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - TERRAZZO FINISHER - Local 3 Marble & Tile

Effective Date - 08/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$30.67	\$11.49	\$22.34	\$0.00	\$64.50
2	60	\$36.80	\$11.49	\$22.34	\$0.00	\$70.63
3	70	\$42.94	\$11.49	\$22.34	\$0.00	\$76.77
4	80	\$49.07	\$11.49	\$22.34	\$0.00	\$82.90
5	90	\$55.21	\$11.49	\$22.34	\$0.00	\$89.04

Effective Date - 02/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$31.30	\$11.49	\$22.34	\$0.00	\$65.13
2	60	\$37.55	\$11.49	\$22.34	\$0.00	\$71.38
3	70	\$43.81	\$11.49	\$22.34	\$0.00	\$77.64
4	80	\$50.07	\$11.49	\$22.34	\$0.00	\$83.90
5	90	\$56.33	\$11.49	\$22.34	\$0.00	\$90.16

Notes:

Apprentice to Journeyworker Ratio:1:3

TEST BORING DRILLER <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2023	\$47.58	\$9.40	\$17.97	\$0.00	\$74.95
	12/01/2023	\$48.83	\$9.40	\$17.97	\$0.00	\$76.20
	06/01/2024	\$50.31	\$9.40	\$17.97	\$0.00	\$77.68
	12/01/2024	\$51.78	\$9.40	\$17.97	\$0.00	\$79.15
	06/01/2025	\$53.28	\$9.40	\$17.97	\$0.00	\$80.65
	12/01/2025	\$54.78	\$9.40	\$17.97	\$0.00	\$82.15
	06/01/2026	\$56.33	\$9.40	\$17.97	\$0.00	\$83.70
	12/01/2026	\$57.83	\$9.40	\$17.97	\$0.00	\$85.20

For apprentice rates see "Apprentice- LABORER"

TEST BORING DRILLER HELPER <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2023	\$43.70	\$9.40	\$17.97	\$0.00	\$71.07
	12/01/2023	\$44.95	\$9.40	\$17.97	\$0.00	\$72.32
	06/01/2024	\$46.43	\$9.40	\$17.97	\$0.00	\$73.80
	12/01/2024	\$47.90	\$9.40	\$17.97	\$0.00	\$75.27
	06/01/2025	\$49.40	\$9.40	\$17.97	\$0.00	\$76.77
	12/01/2025	\$50.90	\$9.40	\$17.97	\$0.00	\$78.27
	06/01/2026	\$52.45	\$9.40	\$17.97	\$0.00	\$79.82
	12/01/2026	\$53.95	\$9.40	\$17.97	\$0.00	\$81.32

For apprentice rates see "Apprentice- LABORER"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
TEST BORING LABORER <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2023	\$43.58	\$9.40	\$17.97	\$0.00	\$70.95
	12/01/2023	\$44.83	\$9.40	\$17.97	\$0.00	\$72.20
	06/01/2024	\$46.31	\$9.40	\$17.97	\$0.00	\$73.68
	12/01/2024	\$47.78	\$9.40	\$17.97	\$0.00	\$75.15
	06/01/2025	\$49.28	\$9.40	\$17.97	\$0.00	\$76.65
	12/01/2025	\$50.78	\$9.40	\$17.97	\$0.00	\$78.15
	06/01/2026	\$52.33	\$9.40	\$17.97	\$0.00	\$79.70
	12/01/2026	\$53.83	\$9.40	\$17.97	\$0.00	\$81.20
For apprentice rates see "Apprentice- LABORER"						
TRACTORS/PORTABLE STEAM GENERATORS <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2023	\$53.69	\$14.75	\$16.15	\$0.00	\$84.59
	12/01/2023	\$54.93	\$14.75	\$16.15	\$0.00	\$85.83
	06/01/2024	\$56.21	\$14.75	\$16.15	\$0.00	\$87.11
	12/01/2024	\$57.65	\$14.75	\$16.15	\$0.00	\$88.55
	06/01/2025	\$58.93	\$14.75	\$16.15	\$0.00	\$89.83
	12/01/2025	\$60.37	\$14.75	\$16.15	\$0.00	\$91.27
	06/01/2026	\$61.65	\$14.75	\$16.15	\$0.00	\$92.55
	12/01/2026	\$63.09	\$14.75	\$16.15	\$0.00	\$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
TRAILERS FOR EARTH MOVING EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2023	\$39.82	\$14.57	\$17.29	\$0.00	\$71.68
	12/01/2023	\$39.82	\$14.57	\$18.67	\$0.00	\$73.06
	01/01/2024	\$39.82	\$15.07	\$18.67	\$0.00	\$73.56
	06/01/2024	\$40.82	\$15.07	\$18.67	\$0.00	\$74.56
	12/01/2024	\$40.82	\$15.07	\$20.17	\$0.00	\$76.06
	01/01/2025	\$40.82	\$15.57	\$20.17	\$0.00	\$76.56
	06/01/2025	\$41.82	\$15.57	\$20.17	\$0.00	\$77.56
	12/01/2025	\$41.82	\$15.57	\$21.78	\$0.00	\$79.17
	01/01/2026	\$41.82	\$16.17	\$21.78	\$0.00	\$79.77
	06/01/2026	\$42.82	\$16.17	\$21.78	\$0.00	\$80.77
	12/01/2026	\$42.82	\$16.17	\$23.52	\$0.00	\$82.51
	01/01/2027	\$42.82	\$16.77	\$23.52	\$0.00	\$83.11
TUNNEL WORK - COMPRESSED AIR <i>LABORERS (COMPRESSED AIR)</i>	06/01/2023	\$55.81	\$9.40	\$18.42	\$0.00	\$83.63
	12/01/2023	\$57.06	\$9.40	\$18.42	\$0.00	\$84.88
	06/01/2024	\$58.54	\$9.40	\$18.42	\$0.00	\$86.36
	12/01/2024	\$60.01	\$9.40	\$18.42	\$0.00	\$87.83
	06/01/2025	\$61.51	\$9.40	\$18.42	\$0.00	\$89.33
	12/01/2025	\$63.01	\$9.40	\$18.42	\$0.00	\$90.83
	06/01/2026	\$64.56	\$9.40	\$18.42	\$0.00	\$92.38
	12/01/2026	\$66.06	\$9.40	\$18.42	\$0.00	\$93.88
For apprentice rates see "Apprentice- LABORER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
TUNNEL WORK - COMPRESSED AIR (HAZ. WASTE) <i>LABORERS (COMPRESSED AIR)</i>	06/01/2023	\$57.81	\$9.40	\$18.42	\$0.00	\$85.63
	12/01/2023	\$59.06	\$9.40	\$18.42	\$0.00	\$86.88
	06/01/2024	\$60.54	\$9.40	\$18.42	\$0.00	\$88.36
	12/01/2024	\$62.01	\$9.40	\$18.42	\$0.00	\$89.83
	06/01/2025	\$63.51	\$9.40	\$18.42	\$0.00	\$91.33
	12/01/2025	\$65.01	\$9.40	\$18.42	\$0.00	\$92.83
	06/01/2026	\$66.56	\$9.40	\$18.42	\$0.00	\$94.38
	12/01/2026	\$68.06	\$9.40	\$18.42	\$0.00	\$95.88
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - FREE AIR <i>LABORERS (FREE AIR TUNNEL)</i>	06/01/2023	\$47.88	\$9.40	\$18.42	\$0.00	\$75.70
	12/01/2023	\$49.13	\$9.40	\$18.42	\$0.00	\$76.95
	06/01/2024	\$50.61	\$9.40	\$18.42	\$0.00	\$78.43
	12/01/2024	\$52.08	\$9.40	\$18.42	\$0.00	\$79.90
	06/01/2025	\$53.58	\$9.40	\$18.42	\$0.00	\$81.40
	12/01/2025	\$55.08	\$9.40	\$18.42	\$0.00	\$82.90
	06/01/2026	\$56.63	\$9.40	\$18.42	\$0.00	\$84.45
	12/01/2026	\$58.13	\$9.40	\$18.42	\$0.00	\$85.95
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - FREE AIR (HAZ. WASTE) <i>LABORERS (FREE AIR TUNNEL)</i>	06/01/2023	\$49.88	\$9.40	\$18.42	\$0.00	\$77.70
	12/01/2023	\$51.13	\$9.40	\$18.42	\$0.00	\$78.95
	06/01/2024	\$52.61	\$9.40	\$18.42	\$0.00	\$80.43
	12/01/2024	\$54.08	\$9.40	\$18.42	\$0.00	\$81.90
	06/01/2025	\$55.58	\$9.40	\$18.42	\$0.00	\$83.40
	12/01/2025	\$57.08	\$9.40	\$18.42	\$0.00	\$84.90
	06/01/2026	\$58.63	\$9.40	\$18.42	\$0.00	\$86.45
	12/01/2026	\$60.13	\$9.40	\$18.42	\$0.00	\$87.95
For apprentice rates see "Apprentice- LABORER"						
VAC-HAUL <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2023	\$39.24	\$14.57	\$17.29	\$0.00	\$71.10
	12/01/2023	\$39.24	\$14.57	\$18.67	\$0.00	\$72.48
	01/01/2024	\$39.24	\$15.07	\$18.67	\$0.00	\$72.98
	06/01/2024	\$40.24	\$15.07	\$18.67	\$0.00	\$73.98
	12/01/2024	\$40.24	\$15.07	\$20.17	\$0.00	\$75.48
	01/01/2025	\$40.24	\$15.57	\$20.17	\$0.00	\$75.98
	06/01/2025	\$41.24	\$15.57	\$20.17	\$0.00	\$76.98
	12/01/2025	\$41.24	\$15.57	\$21.78	\$0.00	\$78.59
	01/01/2026	\$41.24	\$16.17	\$21.78	\$0.00	\$79.19
	06/01/2026	\$42.24	\$16.17	\$21.78	\$0.00	\$80.19
	12/01/2026	\$42.24	\$16.17	\$23.52	\$0.00	\$81.93
01/01/2027	\$42.24	\$16.77	\$23.52	\$0.00	\$82.53	
WAGON DRILL OPERATOR <i>LABORERS - ZONE 2</i>	06/01/2023	\$37.71	\$9.40	\$16.89	\$0.00	\$64.00
	12/01/2023	\$38.61	\$9.40	\$16.89	\$0.00	\$64.90
For apprentice rates see "Apprentice- LABORER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
WAGON DRILL OPERATOR (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY & HIGHWAY)</i>	06/01/2023	\$37.71	\$9.40	\$16.89	\$0.00	\$64.00
	12/01/2023	\$38.61	\$9.40	\$16.89	\$0.00	\$64.90
	06/01/2024	\$39.94	\$9.40	\$16.89	\$0.00	\$66.23
	12/01/2024	\$41.27	\$9.40	\$16.89	\$0.00	\$67.56
	06/01/2025	\$42.66	\$9.40	\$16.89	\$0.00	\$68.95
	12/01/2025	\$44.04	\$9.40	\$16.89	\$0.00	\$70.33
	06/01/2026	\$45.48	\$9.40	\$16.89	\$0.00	\$71.77
	12/01/2026	\$46.92	\$9.40	\$16.89	\$0.00	\$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)						
WASTE WATER PUMP OPERATOR <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2023	\$54.28	\$14.75	\$16.15	\$0.00	\$85.18
	12/01/2023	\$55.53	\$14.75	\$16.15	\$0.00	\$86.43
	06/01/2024	\$56.83	\$14.75	\$16.15	\$0.00	\$87.73
	12/01/2024	\$58.28	\$14.75	\$16.15	\$0.00	\$89.18
	06/01/2025	\$59.58	\$14.75	\$16.15	\$0.00	\$90.48
	12/01/2025	\$61.03	\$14.75	\$16.15	\$0.00	\$91.93
	06/01/2026	\$62.33	\$14.75	\$16.15	\$0.00	\$93.23
	12/01/2026	\$63.78	\$14.75	\$16.15	\$0.00	\$94.68
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
WATER METER INSTALLER <i>PLUMBERS & GASFITTERS LOCAL 12</i>	09/03/2023	\$66.44	\$14.07	\$18.86	\$0.00	\$99.37
	03/03/2024	\$68.24	\$14.07	\$18.86	\$0.00	\$101.17
	09/01/2024	\$70.04	\$14.07	\$18.86	\$0.00	\$102.97
	03/02/2025	\$71.34	\$14.32	\$19.11	\$0.00	\$104.77
For apprentice rates see "Apprentice- PLUMBER/PIPEFITTER" or "PLUMBER/GASFITTER"						

Additional Apprentice Information:

Minimum wage rates for apprentices employed on public works projects are listed above as a percentage of the pre-determined hourly wage rate established by the Commissioner under the provisions of the M.G.L. c. 149, ss. 26-27D. Apprentice ratios are established by the Division of Apprenticeship Training pursuant to M.G.L. c. 23, ss. 11E-11L.

All apprentices must be registered with the Division of Apprenticeship Training in accordance with M.G.L. c. 23, ss. 11E-11L.

All steps are six months (1000 hours.)

Ratios are expressed in allowable number of apprentices to journeymen or fraction thereof, unless otherwise specified.

** Multiple ratios are listed in the comment field.

*** APP to JM; 1:1, 2:2, 2:3, 3:4, 4:4, 4:5, 4:6, 5:7, 6:7, 6:8, 6:9, 7:10, 8:10, 8:11, 8:12, 9:13, 10:13, 10:14, etc.

**** APP to JM; 1:1, 1:2, 2:3, 2:4, 3:5, 4:6, 4:7, 5:8, 6:9, 6:10, 7:11, 8:12, 8:13, 9:14, 10:15, 10:16, etc.